PEDIATRIC CLINICS OF NORTH AMERICA

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FOREWORD

CARL C. FISCHER, M.D.

Consulting Editor

Original plans for this volume called for the simultaneous publication of two symposia, one on the Handicapped Child and the other on Preventive Pediatrics.

It soon became evident to the Consulting Editor that these two subjects are inseparable, for no adequate coverage of the problems of the care of the handicapped child would be complete without ample discussion of preventive pediatrics, just as no phase of preventive pediatrics can be completely divorced from the handicaps which would result if it were not successfully applied.

For this reason it was decided to present this symposium in four sections.

The first of these sections deals with the prevention of handicaps in children, which may be further subdivided into (*a*) perinatal factors, (*b*) prevention of infection through immunizations, (*c*) accident prevention, and (*d*) the role of the well-child conference.

The second phase of the problem is the care of the child with handicaps, subdivided into (*a*) sensory defects—(1) visual, (2) auditory, (3) speech and reading problems; (*b*) muscular defects—cerebral palsy and the like; (*c*) dental handicaps; (*d*) emotional and social handicaps.

The third section is on the education and training of children with handicaps, and the final section deals with the community and the handicapped child.

Reliable sources inform us that one out of every 10 children in the United States has one or another handicap which interferes with his normal emotional, intellectual or physical growth and development. These same sources suggest that one third of these children have a single handicap only, that a second third has two handicaps and the remain-

ing third multiple handicaps to combat. These figures give us some concept of the enormity of the problem confronting everyone working in the field of child care.

During the past quarter century increasing numbers of people have begun to be aware of the problem, and sporadic steps have been taken here and there to aid these children.

Naturally enough, in most instances this has taken the form of an organization of a group of people interested in one particular type of physical defect, so that as time goes on the multiplicity of agencies and groups, each interested in one small phase of the over-all problem, has increased to a proportion which would seem to threaten the over-all needs of handicapped children.

For this reason the emphasis in this symposium will be upon the child with a handicap and not the handicap itself, realizing that the handicapped child is a total personality, a whole child, whose handicap does not change this central fact.

Similarly, it is obvious that a child with any type of handicap must of necessity have emotional, social and educational problems, even though they may at times seem to be somewhat peculiar to the type of handicap. Recalling, also, the frequency of multiplicity of handicaps, it is equally obvious that a broad approach is essential. For this reason the outline indicated earlier is followed.

It is hoped that through the reading of such a symposium many more physicians interested in pediatrics throughout the United States will be stimulated to take a greater interest and to play a larger and more important role in the solution of this problem.

At the same time it is hoped that the workers in many ancillary fields which are important to the total care of the handicapped child will be brought into a coordinated program under the guidance of the pediatrician and family physician.

Finally, this symposium is dedicated to the millions of children whose future health and happiness depend upon the development of a coordinated and effective approach to their problem.

PERINATAL FACTORS IN THE PREVENTION OF HANDICAPS

ROBERT E. COOKE, M.D.

GERARD B. ODELL, M.D.

With the increasing control of acute disease, greater awareness of the chronic problems of infancy and childhood has resulted. The need for preventing chronic handicapping conditions because of their irreversibility has led to a more modern conception of preventive pediatrics: namely, the concern with the genesis of chronic disabilities of the child. Most of these disabilities result from disturbances in fetal or neonatal life, so that a significant part of any section of preventive pediatrics belongs in a department of obstetrics as well as in a department of pediatrics. The increase of medical knowledge which requires continued specialization has made it difficult for the pediatrician or obstetrician to be completely informed of the necessary preventive aspects of handicapping conditions arising in the prenatal and postnatal periods. Therefore, if optimal rather than minimal care is to be provided, a team approach is required throughout pregnancy. Such an approach requires introduction of the pediatrician to the family early in the pregnancy. Pediatricians, therefore, are obligated to learn more of the natural history of pregnancy and labor. One should not conclude that the general practitioner is better qualified than a combination of specialists, because only by having available an expert in each field can the complications of intrauterine and extrauterine life be anticipated and prevented. Furthermore, the argument that most patients do well regardless of care is no longer tenable. All pregnancies must be handled in this manner, since abnormal conditions may occur in any pregnancy and will not be detected unless specifically searched for.

The magnitude of the problem of chronic handicapping disorders is illustrated in part by the study of Miller at the University of Kansas

Medical Center.[26] Out of 4094 consecutive newborns and stillbirths weighing more than 1000 gm., 2.2 per cent had either congenital malformations or disease states caused by maternal syphilis, diabetes or isoimmunization. Congenitally determined diseases and defects occurred in 7 per cent of premature infants and 1.6 per cent of full-term infants. To this number there must also be added disorders of physical, intellectual or emotional growth and development, which are the result of fetal or neonatal disease, but do not become manifest until childhood.

SCOPE OF THE PROBLEM

Reference to genetic disorders will be made only in regard to those specific diseases for which definitive preventive therapy can be given in the prenatal or neonatal period. The scope of the problem to be discussed can be gleaned from Table 1. Almost every system of the body

TABLE 1. *Examples of Chronic Handicaps Preventable or Modifiable in "Perinatal" Period*

Central nervous system	Mental retardation, cerebral palsy, epilepsy, behavior disorders, speech defects
Special senses	Blindness, deafness
Musculoskeletal	Clubfoot, brachial plexus palsies
Pulmonary	Cystic fibrosis of pancreas, asthma
Cardiovascular	Congenital heart disease, myocarditis
Gastrointestinal	Cirrhosis
Genitourinary	Obstructive uropathy
Endocrine	Adrenal hyperplasia

may be altered by environmental influences acting in the fetal or neonatal period. Many of the conditions or symptoms, such as mental retardation, cerebral palsy, epilepsy, behavior disorders, blindness and deafness, have multiple etiologies. They are included in the table because many of the cases in each category can now be prevented or modified by applying the results of recent clinical and experimental research to the conduct of every pregnancy, labor and neonatal period.

Infantile cirrhosis may be cited as a specific example. Studies have established that the virus producing homologous serum jaundice may be introduced by means of improperly sterilized blood-letting equipment. Likewise, this virus may be transmitted transplacentally and produce neonatal hepatitis,[34] which may lead to infantile cirrhosis and chronic hepatic insufficiency. Only by taking specific precautionary measures (such as avoiding the reusing of all needles, lancets, and the like) can the practicing physician, particularly the obstetrician, avoid this rare but preventable handicap.

Many of the other chronic handicapping conditions listed in Table 1 are not completely preventable. Cystic fibrosis of the pancreas is a

genetic disease. By the early recognition of this disorder, however, therapy may be given which can modify the progress of the disease, minimize morbidity and extend longevity. In such a case early diagnosis depends upon obtaining an adequate family history with a pediatric orientation.

Nowhere is this principle better exemplified than in the modification of the allergic diathesis. Glaser and Johnstone[14] have shown that in families with a strong history of allergy the onset of major allergic manifestations in an infant or child may be delayed or prevented by the avoidance of food excesses during pregnancy and by the use of a hypoallergenic feeding mixture from birth through the early months of life. The evidence of major allergy was 15 per cent in the experimental group receiving hypoallergenic feedings, 64 per cent in sibling controls and 52 per cent in nonrelated subjects. What factors are primarily responsible for the results obtained in their study is still not firmly established.

Other chronic handicaps, such as clubfoot, obstructive uropathy, adrenal hyperplasia, which are listed in Table 1, are in no way readily preventable. The course of the disorder can be radically altered, however, by early diagnosis and therapy. For example, the early recognition of the adrenogenital syndrome in the female and the adequate treatment of this condition with steroid will prevent subsequent psychologic trauma and dwarfing.[36] The recognition of these disorders depends upon the physician's maintenance of a high index of suspicion, which at times may be blunted by many hours spent in the routine care of well children. The necessary intellectual curiosity can be maintained only by continued self-education through reading as well as by active participation in medical societies', hospitals' or universities' pediatric teaching exercises.

PERINATAL FACTORS RESPONSIBLE FOR HANDICAPPING CONDITIONS

From the preceding paragraphs the reader can see that the usual definition of "perinatal" has been expanded to include the whole of pregnancy and the neonatal period. This definition would thus include the prevention of defects, not of genetic origin, which may result from disease occurring both early and late in fetal life. For convenience, the perinatal period is divided into a prenatal period, a paranatal period covering labor, and a neonatal period covering the first month of extrauterine life (Table 2).

TABLE 2. *Authors' Concept of Scope of "Perinatal" Period*

Prenatal (predelivery)	Conception to onset of labor
Paranatal (delivery)	Onset of labor to live birth
Neonatal (postdelivery)	Live birth to one month

Table 3 lists many of the factors responsible for injury to the fetus or neonate which may be prevented or modified. This is in no way a complete analysis, but is limited to the more common practical problems.

TABLE 3. *Examples of Possibly Preventable or Modifiable "Perinatal" Factors Associated with the Chronic Handicaps of Infancy and Childhood*

	PRENATAL
Infection	Rubella, cytomegalic inclusion body disease, toxoplasmosis, syphilis, pneumonia, hepatitis virus
Chemical	Anoxia, deficiency states, pyridoxine excess, vitamin D excess
Endocrine	Maternal thyroid disease, maternal diabetes
Placental	Toxemia, abruptio placentae, marginal sinus rupture, placenta previa, hydramnios, trauma, premature rupture of membranes
Radiation	X-ray, radium therapy, atomic
Immunologic	Fetal-maternal blood group or other incompatibility, specific food excesses
	PARANATAL
Infection	Gonorrhea, herpes, pulmonary aspiration
Chemical	Anoxia, barbiturates, narcotics, anesthetics
Cardiovascular	Maternal hypotension, fetal hemorrhage
Mechanical	Cephalopelvic disproportion, precipitate delivery, cesarean section, uterine spasm, breech, Pitocin induction
Prematurity	
Postmaturity	
	NEONATAL
Infection	Coxsackie B, Staphylococcus aureus, pyocyaneus
Chemical	Anoxia, hyper-indirect-bilirubinemia, vitamin K excess, naphthalene, lactose or galactose (galactosemia), phenylalanine (phenylpyruvic oligophrenia), hyperosmolarity, oxygen poisoning, parenteral Gantrisin
Immunologic	Blood group incompatibility, milk proteins or other antigens
Endocrine	Cretinism
Physical	Hyperthermia
Iatrogenic	Delayed recognition of orthopedic defects, subdural hematoma, cystic fibrosis, etc. + some of above.

Infections

In each phase of the "perinatal" period the action of pathogenic microorganisms may lead to injury of various organs with serious sequelae. In fetal life such diseases as rubella, cytomegalic inclusion body disease, toxoplasmosis, syphilis, herpes and others can lead to irreversible damage, particularly to the central nervous system. Even postnatally, sepsis, meningitis and staphylococcal pneumonia can produce irreversible changes leading to chronic invalidism. It is possible at present that some of these conditions may be eliminated completely as factors in the production of chronic disabilities in childhood. For example, all

parents should be encouraged to expose their daughters to German measles before the child-bearing period. This procedure alone would prevent the devastating effects on the fetus of rubella in early pregnancy. Although it has been demonstrated that serologic testing for syphilis premaritally and prenatally can almost completely abolish congenital syphilis, there are still several states that do not require such examinations. In the last few months we have observed at the Harriet Lane Home two cases of congenital syphilis, both with severe residuals that could have been prevented completely if serologic tests for syphilis had been performed during the pregnancy and adequate therapy given. Severe myocarditis and myocardial insufficiency in infants recently has been demonstrated to be caused by the Coxsackie group B virus.[17] To prevent this postnatal complication every effort should be made to avoid exposure of newborn infants to personnel suffering from Coxsackie-like infections.

Radiation

The production of microcephaly by radiation of the fetus in utero can be avoided if exposure is prevented until at least the fifth or sixth month of gestation.[29] Experimental studies recently have shown that interference with brain development is due to the direct effects of radiation on the fetus, rather than to induced systemic changes in the mother.[3] Therefore, if x-ray must be used early in pregnancy, adequate shielding of the fetus should be carried out. Routine pelvimetry, which is an essential in all primiparous women, should be deferred until the seventh month of gestation.

Chemical Factors

It would be impossible to list all the chemical agents that may harm the fetus or newborn. A few are selected. Anoxia at any period of development can lead to rapid death of neurons and other tissue. The particular sequelae depend upon the stage of fetal development, and the residuals may not be specific for anoxia, but for any comparable stress occurring at that stage of development.[16] Paranatal and neonatal anoxia will be dealt with more fully in a later section. Although vitamin deficiency has been shown in experimental animals to be teratogenic, in human beings it is rarely the basis of congenital anomalies. By contrast, excessive intake of vitamin B_6 may lead to alterations in the fetus or newborn. Pyridoxine dependency has been described as a basis for convulsive disorders.[15] Likewise, excessive intake of vitamin D during pregnancy or hypersensitivity to vitamin D may be responsible for infantile idiopathic hypercalcemia of the severe type.[32] This disease has

been observed relatively frequently in England, where vitamin D intake is high. The affected child has a characteristic facial configuration and craniostenosis suggesting prenatal or neonatal origin. Permanent brain damage is almost always associated with this disorder.

Endocrine Factors

Recent studies in maternal fetal hormonal relationships have provided the opportunity for prevention of certain defects that may result from *thyroid dysfunction*. In the presence of a positive family history of cretinism or of maternal thyroid disease, serial measurements of circulating hormone (BEI) of the mother should be obtained. Replacement therapy adequate to maintain the high blood level characteristic of pregnancy must be given in order to prevent prenatal or postnatal arrest of brain development.[8, 28] In addition, the evaluation of the offspring of such mothers by appropriate laboratory methods is essential for the early diagnosis and treatment of cretinism. Only in this way can central nervous system residuals be prevented.

There is little doubt that maternal *diabetes* is associated with an increased incidence of obstetrical complications as well as extreme neonatal morbidity and mortality. If the concept of "a continuum of reproductive casualty" as postulated by Lillienfeld and Pasamanick[22] is correct, then some chronic handicaps of childhood must result from maternal diabetes. This generally accepted concept indicates that in those conditions in which fetal mortality is high, a high incidence of neuropsychiatric disorders may be expected. Infant mortality is high even when there is excellent control of the diabetes, but the mortality rate rises as high as 25 to 50 per cent if the diabetes is poorly controlled near term and particularly if ketosis is present. Hospitalization of the diabetic mother with strict hour-by-hour regulation over the last few weeks of pregnancy may be necessary to improve prognosis and prevent fetal difficulties. The optimal management of every pregnant diabetic woman requires the closest cooperation of obstetrician, internist, pediatrician and patient. Likewise, the care of the offspring of the diabetic mother requires handling similar to that of the premature, even though the infant is extraordinarily large.[27]

Obstetrical Factors

The number of obstetrical factors that lead to chronic injury to the fetus is large. Since this paper is weighted heavily toward pediatric aspects, obstetrical factors will be discussed only in a cursory fashion. The statistical studies of Lillienfeld, Pasamanick and Rogers[23] as well as others have demonstrated a positive correlation between complica-

tions of pregnancy (toxemia, breech presentation, premature separation of placenta, placenta previa, prolapse of the cord, precipitate delivery) and neuropsychiatric disorders of childhood. In addition, such injuries as brachial plexus paralysis (Erb's or Klumpke's palsy) with or without phrenic nerve paralysis occur with greatly increased frequency in breech extractions.[35]

Although other mechanical factors, such as cephalopelvic disproportion, may lead to cerebral trauma and hemorrhage, severe *anoxia* is a more likely cause of the brain injury which results, rather than mechanical trauma. Although it is difficult to be certain whether or not brain damage is the cause or the sequel of anoxia, there are indications that in some cases at least cerebral changes are produced by the anoxia alone. The experimental studies of Windle and Becker[37] prove that severe brain damage may occur as a result of anoxia during delivery. The occurrence of anoxia is more likely just prior to or during delivery than in the postnatal period. The recent studies of Schaffer and Pearlman[31] suggest that massive aspiration of amniotic contents secondary to anoxia just prior to delivery may be a significant yet frequently ignored cause of subsequent severe respiratory distress. Therefore there is great need for accurate recording of the fetal heart rate during labor to detect early fetal distress, and routine oxygen administration to the mother during the second stage of labor should be mandatory. By the administration of oxygen during this period, Prystowsky,[30] in the Department of Obstetrics at Johns Hopkins, has demonstrated that the oxygen tension of the intervillous space rises significantly, as do the oxygen tension and saturation of fetal blood in the umbilical veins and arteries. These higher oxygen levels provide an increased margin of safety for the infant in case of sudden arrest of placental blood flow, kinking of the cord, aspiration, and so on. Delivery by cesarean section should be restricted to those cases in which there are definite obstetrical indications. Maternal anoxia and hypotension should be avoided throughout the procedure. The head should be delivered first to avoid massive aspiration.

Postmaturity

Although the exact mechanism responsible for the postmature state is unknown, there is ample evidence for increased mortality and morbidity of the postmature infant born to a primiparous mother.[7] Late sequelae in these infants are also more frequent than normal. Relative anoxia from placental insufficiency has been suggested as the cause of these difficulties. Recent studies indicate that this may not be the entire basis for the fetal disturbances. Regardless of the cause of the difficulties, proper therapy consists in the interruption of pregnancy at 42 weeks if

gestation can be timed accurately. The care of the postmature newborn should be modeled after the care of the premature.

Prematurity

This problem will be discussed in a subsequent section.

PREVENTATIVE PROCEDURES

Much of the foregoing discussion may be translated into a practical program, many aspects of which are in general use, whereas others are just being developed. Table 4 is a compendium of many specific procedures designed to prevent chronic childhood handicaps. Many items in the table are self-explanatory and need not be elaborated upon. In general, most of the procedures require close liaison between obstetrician and pediatrician, so that the latter may anticipate possible difficulties from the past medical history of the mother and father and from

TABLE 4. *Examples of Specific Procedures to Prevent Chronic Handicaps*

PRECONCEPTION
Rubella in childhood
Poliomyelitis vaccine in childhood
Detailed P.H. and F.H.
PRENATAL
Infection
Diagnosis and therapy—maternal syphilis, gonorrhea
Adequately sterilized equipment—avoid serum hepatitis
Isolation from animal carriers—toxoplasmosis (? cats)
Radiation
Avoid diagnostic x-rays first trimester
X-ray pelvimetry primipara last trimester
X-ray—fetal distal femoral epiphysis before elective cesarean section or induction of labor
Dietary
Avoid specific food excesses
Adequate, not excessive intake—vitamins, minerals, protein, calories
Endocrine
Strict regulation maternal diabetes. No ketosis
Serial BEI with F.H. of cretinism or maternal thyroid dysfunction
Adequate replacement therapy
Immunologic
Complete blood typing
Serial anti-Rh titers—mother Rh negative, father Rh positive
Avoid premature induction unless repeated history of term stillbirths
Maternal Complications
Adequate therapy for toxemia
Delay premature labor
Avoid breech presentation
Interrupt postmaturity

TABLE 4. (*Continued*)

PARANATAL
Anesthesia
Avoid excessive narcosis, analgesia, systemic anesthesia
Avoid maternal hypotension
Routine oxygen therapy to mother—second stage
Obstetrical
Careful observation of fetal heart rate
Optimal conduct of premature labor
Maintain fetal head below body until well suctioned
Avoid unnecessary cesarean section
Extract head first in cesarean section
Avoid precipitate delivery
Avoid excessive Pitocin induction

NEONATAL
Resuscitation
Apgar scoring system as routine
Endotracheal controlled positive pressure if score is low
Adequate nasopharyngeal suction
Gastric suction—cesarean section, maternal diabetes, postmature
Laboratory
Serial bilirubin—fetal-maternal blood group incompatibility, all prematures, congenital hemolytic anemias, all early (first 48 hours) jaundice
Hemoglobin or microhematocrit—placenta previa
Blood culture—change in course, fever, jaundice
BEI—positive F.H. of cretinism
Serial urines—phenylpyruvic acid ($FeCl_3$ test) if positive F.H. for phenylketonuria
Serial urines—reducing substance (Benedict's test) if positive F.H. for galactosemia
Transfusion
Fetal hemorrhage
Exchange transfusion—early fetal-maternal blood group incompatibility or hemolytic anemia
Exchange transfusion—large and slow—to prevent *hyper-indirect-bilirubinemia* regardless of cause
Poisoning
Oxygen
Vitamin K
Parenteral Gantrisin
Naphthalene
Isolation
Avoid Coxsackie, herpes, Staphylococcus aureus contact
Feeding
Adequate H_2O in relation to solute
Hypoallergenic mixtures—strong F.H. of allergy
Lactose free diet—galactosemia
Low phenylalanine diet—phenylpyruvic oligophrenia
General
Careful observation of respiratory rate
Careful nursing observation for jaundice
Prevention of bleeding diathesis
Careful orthopedic evaluation

the family history. It is worth pointing out here that the presence of this team of physicians need not precipitate anxiety in the expectant parents if this approach is explained as a routine accepted procedure.

Prematurity

One of the main problems in the prevention of chronic handicaps in childhood is the prevention of prematurity. The recent study of Knoblock, Rider, Harper and Pasamanick[20] clearly indicates that serious neurologic disorders and developmental retardation occur with significantly greater frequency in premature than in the comparably matched control series of full-term infants. Not all the reasons for this relationship are obvious.

Associated with prematurity is an increased incidence of maternal complications, such as toxemia, implantation abnormalities and cesarean section which by themselves lead to increased infant morbidity and mortality. A significant number of premature births seem to be due to no more than the premature onset of labor. In such cases it is possible that hormones, such as uterine relaxing hormone of hog corpora lutea,[24] may be effective. The use of other hormone preparations is still undergoing clinical trial. The premature induction of labor or too early elective cesarean section can be avoided usually by roentgenograms of the fetus just prior to induction in order to ascertain the presence of the distal femoral epiphysis. This center of ossification can be demonstrated in 90 per cent of all full-term infants.

The delivery of the premature requires particular emphasis. The outline of obstetrical procedures for prematures as given by Larsson[21] points out that, if possible, no analgesia should be administered. The anesthesia should be spinal, caudal or local, the last being preferable. Delivery should be by means of outlet low forceps with an average episiotomy. Larrsson recommends that the cord not be clamped until the pulsations have ceased for some time. This question is still debatable, however. Infant respiratory passages should be cleared adequately by bulb syringe with the head maintained below the body. Although not emphasized by Larrsson, it is essential, as indicated in the previous section, that oxygen be administered to the mother throughout the second stage of labor.

In the care of the premature in the neonatal period, the prevention of future handicaps can be facilitated by gentle handling with avoidance of the marked head-down position in order to minimize cerebral hemorrhage, which is a frequent complication in these infants. Of greater significance has been the demonstration of the need for the control of oxygen therapy. Excellent studies[18] have demonstrated beyond doubt that retrolental fibroplasia may be prevented by the avoid-

ance of high oxygen tensions. The restriction of the use of oxygen in the treatment of severe respiratory insufficiency and cyanosis was accompanied by no increase in neonatal mortality and a remarkable prevention of blindness in these infants as compared with the controls. The routine use of oxygen therapy for prematures should be abolished. In those infants requiring oxygen therapy, concentrations greater than 40 per cent should be avoided. Actually, this concentration doubles the partial pressure of oxygen in the alveoli and blood. A number of devices and procedures have been recommended for the control of oxygen concentrations in premature incubators, and frequent sampling with a calibrated oxygen analyzer has been recommended. All these devices and procedures have certain unavoidable errors. The only fool-proof method is the administration of oxygen in mixtures with nitrogen which permit absolute control of the oxygen concentration. Such mixtures are available from commercial oxygen suppliers. Since the development of retrolental fibroplasia in the future will undoubtedly have medicolegal implications, hospitals should use mixtures of oxygen and nitrogen which can be analyzed by the hospital before use, or guarantees should be obtained from the commercial suppliers as to the exact composition of the oxygen-nitrogen mixtures.

The other point in premature care which should be emphasized is the need for frequent close observation for the detection of jaundice and the routine serial determination of bilirubin concentration in capillary blood. This subject will be discussed in greater detail in a following section.

Because of the immaturity of the kidney of the premature, feeding mixtures should contain ample water in relation to solutes to prevent the development of hyperosmolarity with its attendant cerebral manifestations. Likewise, because of the limited capacity of the premature to sweat, the temperatures of incubators must be controlled carefully, thereby avoiding physical injury of the brain from hyperthermia.

Resuscitation

At the completion of labor, whether premature, term or postmature, there is need for an objective appraisal of the status of the newborn. The scoring system of Apgar[1] permits some degree of confidence in assessing the optimum time for institution of active resuscitative measures. This system is based upon observation of several easily assessable parameters—breathing, heart rate, muscle tone, response to reflex stimulation, and skin color. The score should be ascertained one minute after delivery and at two minute intervals thereafter. If resuscitation is required because of the deterioration of the Apgar score, it is the authors' opinion that this can be done most effectively by intermittent positive

pressure blasts of short duration through the endotracheal tube according to the technique described by Day[11] and with equipment similar to that designed by Cherniack and Boyd.[6] In this way the high pressure necessary for initial expansion may be given without severe danger of interstitial emphysema. It is our opinion that the dangers of endotracheal intubation in the newborn have been exaggerated. Unquestionably, experience is required. If struggling and resistance are met, the patient does not require intubation or positive pressure insufflation. When respiration is instituted, gastric suction should be carried out in all infants delivered by cesarean section, postmature babies and babies born to diabetic mothers. Repeated suction in such cases may prevent aspiration pneumonitis.

Hyperbilirubinemia

There is increasing evidence that the concentration of indirect bilirubin in body fluids in the first four days of life in full-term infants and in the first six days of life in prematures may be responsible for a large number of cases of cerebral injury in infants dying in the newborn period with pathological evidence of kernicterus. Even more important, however, may be the more subtle sequelae of hyperbilirubinemia which are not recognized for months or years, such as deafness, cerebral palsy, mild or severe mental retardation.[13] Bordley and Hardy[2] pointed out that deafness and behavior disorders may be the only residua of severe jaundice. In another study[12] the psychometric testing of children who were jaundiced in the neonatal period because of Rh incompatability indicated that the intelligence quotient is depressed significantly in comparison with older siblings who had not been jaundiced. Likewise, the high frequency of central nervous system complications in prematures referred to previously may be accounted for in part by hyperbilirubinemia.

The level of indirect bilirubin in body fluids is dependent upon its rate of formation, which is related to the rate of red blood cell destruction, and upon the rate of excretion, which probably is related to the rate of conjugation of bilirubin with glucuronic acid by liver cells to form direct bilirubin.[33] Hyper-indirect-bilirubinemia, therefore, may result from increased hemolysis as in fetal-maternal blood group incompatibility, particularly that due to Rh incompatibility and other congenital hemolytic anemias, or may be due to a decreased excretory rate as in congenital nonhemolytic jaundice with kernicterus described by Crigler and Najjar[9] or to a combination of hemolysis with decreased excretion as in ABO incompatibility. Recent work in our department by Zinkham and Childs[38] indicates that red blood cells of certain Negroes as well as most newborns contain inadequate amounts of re-

duced glutathione. This sulfhydryl compound may be necessary for maximum resistance against hemolysis.[19] Excessive doses of vitamin K[10] and other naphthalene-like derivatives may depress reduced glutathione levels, thereby promoting hemolysis.

A reduced capacity for transport of indirect bilirubin across liver cells leads to hyperbilirubinemia and may cause kernicterus in the newborn in the absence of increased hemolysis. The recent studies of Brown and Zuelzer[4] indicate that severe jaundice may be present in full-term infants as well as prematures in the absence of a hemolytic process. To detect such cases the routine examination of all infants by nurses and physicians under adequate lighting must be carried out at least every 12 hours during the first two days of life and at 24 hour intervals thereafter. Only in this way will it be possible to reduce the incidence of central nervous system defects resulting from such elevated levels. In order to guide therapy adequately, it is essential that serial serum bilirubin levels be determined in all such cases and routinely in all premature infants by rapid and simple micromethods. In this way rapidly rising bilirubin levels, regardless of cause, may be detected and further rise may be prevented by exchange transfusions. Although the exact level of bilirubin which leads to brain damage is not known, levels above 18 mg. per 100 ml. must be considered potentially dangerous.[25] Levels as high as 30 mg. are occasionally tolerated. On the other hand, levels as low as 16 mg. per 100 ml. have been shown to produce brain injury.

Exchange Transfusions

Exchange transfusions should be carried out as soon as possible after birth in all cases of iso-immunization due to the Rh factor when proper indications are present. These indications are dependent in part upon communication of the pediatrician with the obstetrician prior to delivery and the obtaining of an adequate family history and history of previous pregnancies. Indications for initial transfusion in an infant with a positive antiglobulin (Coombs' test) are as follows: a cord hemoglobin less than 14.5 gm. per 100 ml., cord bilirubin greater than 4 mg. per 100 ml., previous family history of kernicterus, clinical findings of disease at birth, such as large liver and spleen, and prematurity. In those case histories in which there are repeated stillbirths at term in sensitized mothers, induction of labor at 38 weeks should be carried out with early exchange transfusions of the newborn. In all other cases of hyper-indirect-bilirubinemia and in the case of repeat exchange transfusions for Rh incompatibility, the rate of rise of bilirubin is of value as an indicator of the need for exchange transfusion. When the rate of rise is rapid (greater than 0.5 mg. per 100 ml. per hour) or when the level is

approaching 18 mg., large exchange transfusions—200 to 300 ml. per kilogram of body weight—are carried out over a period of two to three hours in order to remove large amounts of bilirubin from the body. Brown, Zuelzer and Robinson[5] have shown that large quantities of bilirubin are present in extravascular fluids. The use of large volumes of blood exchanged slowly removes bilirubin more completely from these sites and prevents the rapid rebound of plasma bilirubin to high levels.

SUMMARY

Certain preventive measures in the prenatal, paranatal and neonatal periods have been outlined that may reduce the incidence of chronic handicaps in later infancy and childhood. Emphasis is placed on the optimal care that can be given only by a team approach in which pediatrician joins with obstetrician early in pregnancy to plan a course as free of hazards as possible and to implement communications so that prophylactic measures may be initiated as soon as necessary.

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IMMUNIZATION PROCEDURES

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The incidence of certain infectious diseases and resultant handicaps has been greatly reduced in the United States[56, 109] (Table 5). This is in contradistinction to certain other areas of the world where infectious diseases are still a great medical concern.[104, 113] The role of immunization procedures is no doubt the principal factor in bringing about this reduced incidence of diphtheria, smallpox and tetanus[38, 56, 66] in the United States, although other factors such as better living standards, improved nutrition and sanitation, antibacterial therapy, preventive medicine and variations in the microbiological world surrounding us are probably contributory[10, 71] factors in bringing about a reduced incidence of typhoid and paratyphoid fevers, dysentery, rabies and anthrax.

The new baby enters into the community with nonspecific and specific defense mechanisms. A scholarly review of these immune mechanisms available to human newborns as well as to various animal species was recently presented by Edsall.[36] Nonspecific defenses include the intact epithelium, pH, and fatty coating of the skin and mucous membranes; the mucus and lysozyme of tears, saliva and gastric juices; the phagocytes, the reticuloendothelial system and the properdin system.[94, 102]

Specific immune mechanisms are the various types of antibodies, including the agglutinins, bacteriolysins and opsonins, which are active against whole bacteria. Antitoxins are active against the soluble bacterial exotoxins, and the neutralizing antibodies are probably the main antibodies against viruses.

Infants receive a number of antibodies in utero[76, 106] and in this way, depending on the mother's immunities, may receive a passive acquired immunity to measles, rubella, mumps, poliomyelitis, smallpox, chickenpox, as well as antitoxic immunity to diphtheria and scarlet fever.[36, 102] This temporary congenital immunity persists for a variable period up to six months[8, 116] and in the human baby and rodents is not related

TABLE 5. *Reported Cases of Specified Notifiable Diseases: United States, 1920–1955**

	ANTHRAX	DIPHTHERIA	INFECTIOUS HEPATITIS	ACUTE POLIOMYELITIS	MEASLES	TETANUS	RABIES IN MAN	SCARLET FEVER AND STREPTOCOCCAL SORE THROAT	SMALLPOX	TUBERCULOSIS	TYPHOID AND PARATYPHOID	PERTUSSIS
1920	135	147,991	—	2,338	469,924	—	39	161,432	102,128	—	35,994	—
1921	79	206,939	—	6,301	282,074	—	51	193,985	102,787	—	47,250	—
1922	90	172,724	—	2,255	266,067	—	44	162,950	33,378	—	36,307	107,473
1923	147	147,151	—	3,489	761,267	—	54	177,798	30,907	—	34,667	164,191
1924	194	120,452	—	5,262	529,116	—	58	187,346	56,591	—	35,358	165,418
1925	111	95,109	—	6,104	225,027	—	76	187,552	39,572	—	46,350	152,003
1926	135	94,696	—	2,750	689,292	—	82	195,698	33,732	—	41,701	202,210
1927	74	106,924	—	10,533	461,357	—	90	214,057	37,600	—	34,796	181,411
1928	90	91,416	—	5,169	561,872	—	103	179,401	39,396	—	27,198	161,799
1929	79	85,365	—	2,882	366,056	—	80	186,200	42,282	—	23,289	197,371
1930	82	66,576	—	9,220	419,465	—	59	177,837	48,907	—	27,201	166,914
1931	65	70,839	—	15,872	474,879	—	55	206,299	30,233	—	26,548	172,559
1932	48	59,879	—	3,820	403,493	—	54	215,613	11,224	—	26,666	215,343
1933	59	50,462	—	5,043	400,894	—	65	218,966	6,491	—	23,349	179,135
1934	65	43,156	—	7,510	799,455	—	80	227,495	5,371	—	22,217	265,269
1935	61	39,226	—	10,839	743,856	—	77	268,542	7,957	—	18,355	180,518
1936	77	30,018	—	4,523	299,614	—	73	250,487	7,834	—	15,898	147,237
1937	65	28,536	—	9,514	321,510	—	59	236,361	11,673	—	16,033	214,652
1938	52	30,508	—	1,705	822,811	—	66	198,428	14,939	—	14,903	227,319
1939	54	24,053	—	7,343	403,317	—	40	173,162	9,877	—	13,069	183,188
1940	76	15,536	—	9,804	291,162	—	41	165,766	2,795	102,984	9,809	183,866
1941	104	17,987	—	9,086	894,134	—	39	139,424	1,396	105,567	8,601	222,202
1942	94	16,260	—	4,167	547,413	—	36	135,755	865	117,204	5,895	191,383
1943	72	14,811	—	12,450	633,627	—	47	150,362	765	120,253	5,464	141,890
1944	49	14,150	—	19,029	630,291	—	56	200,539	397	126,294	5,127	109,873
1945	40	18,675	—	13,624	146,013	—	43	185,570	346	114,931	4,457	133,792
1946	40	16,354	—	25,698	695,843	—	34	125,511	337	119,256	3,793	109,860
1947	69	12,262	1,092	10,827	222,375	560	26	93,595	176	134,946	4,026	156,517
1948	60	8,493	709	27,726	615,104	601	24	91,295	57	137,006	3,722	74,715
1949	54	7,969	2,027	42,033	625,281	579	10	87,220	49	134,865	4,038	69,479
1950	49	5,796	2,820	33,300	319,124	486	18	64,494	39	121,742	3,717	120,718
1951	60	3,983	7,349	28,386	530,118	506	18	84,151	11	118,491	2,128†	68,687
1952	47	2,960	17,428	57,879	683,077	484	24	113,677	21	109,837	2,341	45,030
1953	45	2,355	33,700	35,592	449,146	506	12	132,935	4	106,925	2,252	37,129
1954	22	2,041	50,093	38,476	682,720	524	13	147,785	39	100,540	2,169	60,886
1955	39	1,984	31,961	28,983	555,156	462	6	147,502	32	98,737	1,704†	62,786

* From Vital Statistics—Special Reports, Natural Summaries, Volume 37, Number 9 (June 15), 1953, and Morbidity and Mortality Weekly Report, Volume 4, Number 53 (September 27), 1956, National Office of Vital Statistics, U.S. Department of Health, Education and Welfare.

† 1951–5 figures for typhoid fever only.

to breast feeding. On the other hand, newborns of ruminants receive a large proportion of passive acquired antibody in the colostrum.[65] Bacteria may be injected into the teat during nursing, and this act calls forth a rapid and large antibody production which is available for the next feeding.[22] In human beings the time of transplacental antibody passage has been found to be late in gestation.[82, 86, 110] The chemical nature of these antibodies has been partially described as both pseudoglobulin and euglobulin in nature.[76, 117]

Newborns receive little or no passive immunity to pertussis, tetanus, tuberculosis, pyogenic infections and gastrointestinal infections. As a result active immunization early in life is especially valuable for pertussis, tetanus and tuberculosis. The ability of newborn and even premature infants to produce antibodies in response to antigens administered early in life has been thoroughly studied.[24, 85] Their response to diphtheria, pertussis and tetanus antigens was in general so good that immunization prior to three months is of practical value.[30, 31, 32] The presence of maternal antibody has been noted to delay the active antibody response, especially to diphtheria and pertussis, but not to inhibit it.[30, 31, 32, 47, 48, 111] Recent studies also indicate that poliomyelitis vaccine administered to infants produces adequate antibody levels.[18, 26]

If an infant is naturally infected while possessing passively acquired immunity, a passive-active immunization process may occur. This is an important phenomenon in certain diseases by which a host-parasite equilibrium may be established.[4, 27, 43] For instance, mouse-pox may be transmitted to newborn mice who have passive immunity, but a subclinical disease develops and permanent active immunity follows. On the other hand, if older adult mice from an uninfected colony are placed in the same infected colony, many will die of mouse-pox.

In human beings passive-active immunization probably occurs in poliomyelitis, especially in populations with poor sanitation,[90, 91, 102] and has been demonstrated to occur experimentally by infecting human newborn babies with measles[51] and poliomyelitis viruses.[61a, 61b] A suggestive study in mumps has also been reported.[105]

At present a number of active and passive immunization procedures have been developed which have aided mankind in attaining a more satisfactory equilibrium with the agents of certain infectious diseases. The purpose of the active immunizing agents is to provide circulating antibodies to the host and to establish a sensitized antibody-producing mechanism which is capable of rapid response to the re-entry of the living microorganism. The following is a review of the currently recommended procedures.

ACTIVE IMMUNIZATION PROCEDURES

Time of Administration

Studies noted above indicate that the separate or combined antigens of diphtheria, tetanus and pertussis may be given early in neo-

natal life with adequate antigenic responses and no adverse reactions.[7, 20, 28, 30, 31, 32, 85, 92, 112] Poliomyelitis vaccine also may be given safely and effectively to newborns.[18, 26] The recommended time for commencing the combined diphtheria, pertussis and tetanus antigens for normal infants is one to two months of age,[98] although many physi-

TABLE 6. *Active Immunization Schedule for Infants*

AGE	PREPARATION	DOSE
1–2 months **2–3 months** **3–4 months**	Triple antigen	0.5 cc.*
5–6 months **7–8 months**	Poliomyelitis vaccine†	1.0 cc.
9–10 months	Smallpox vaccination	Multiple pressure technique over left deltoid or triceps
16 months	Poliomyelitis vaccine	1.0 cc.
	Recall or Booster Schedule	
18 months	Triple antigen	0.5 cc.
4 years	Triple antigen	0.25–0.5 cc.‡
5 years	Smallpox vaccination	
8 years	Diphtheria-tetanus toxoid§ (standard)	0.1 cc.
12 years and every 4 years	Diphtheria-tetanus (adult)‖¶	0.5 cc.

* Diphtheria toxoid approximately 20 Lf./cc.; pertussis, 12 N.I.H. units per 1.5 cc.; tetanus toxoid approximately 20 Lf./cc. (Lf. = limit of flocculation or flocculation unit.)

† May be given concurrently with triple antigen (see text). Need and schedule for booster injections cannot be stated at this time.

‡ Triple antigen not recommended after 5 years of age. Separate pertussis booster may be given at 6–7 years of age.

§ Standard diphtheria-tetanus toxoid not recommended over 10 years of age without preliminary Schick test and toxoid sensitivity test. It contains diphtheria toxoid, approximately 30 Lf./cc., and tetanus toxoid, 20 Lf./cc.

‖ Adult type diphtheria-tetanus toxoid contains 1–2 Lf. of diphtheria toxoid per dose and 5–15 Lf. of tetanus toxoid and may be used without preliminary Schick test and toxoid sensitivity test.

¶ Some authorities have advocated Schick test at age 1 year, 6 years and 10 years and after 10 years of age at the time of tetanus boosters or of diphtheria outbreaks. Although this is accepted practice, it is better to give routine boosters because diphtheria may occur in Schick-negative persons.

cians prefer two to three months of age.[10, 71, 102] Infants respond well at younger ages, and an outbreak of pertussis, diphtheria or poliomyelitis might be an indication to immunize rapidly against these diseases, beginning weekly injections at one week of age, using the separate fluid antigen to obtain a quicker response. A smallpox outbreak would also be an indication for immediate vaccination of all newborns.

Type of Product

The combined antigens of diphtheria, pertussis and tetanus are now recommended for primary immunization of infants and young children.[10, 71, 80, 98] The general consensus in favor of the combined antigens has been due to their superior immunizing power[46] and simplicity, which improve the chances of completing primary immunization and decrease the emotional stress from a larger number of injections. The combined depot preparations of alum- or aluminum phosphate-precipitated or aluminum hydroxide-adsorbed diphtheria and tetanus toxoids with *H. pertussis* vaccine are widely used in the United States, although in Canada and certain areas in the United States the combined fluid preparations without adjuvant are preferred.

The depot preparations are said to produce more prolonged antitoxic immunity and better protection against pertussis in infants. The new purified depot products are less likely to cause systemic reactions than the fluid products. On the other hand, the combined fluid preparations give more rapid protection and are less likely to cause draining sinuses or alum cysts.

Techniques

Needles and syringes should be sterilized by either autoclaving, dry heat at 170° C. for two hours or by boiling 15 minutes. The skin site should be clean and swabbed with 2 per cent tincture of iodine or 70 per cent alcohol or a similar suitable antiseptic.

The use of separate needles for loading the syringe and for injection reduces the likelihood of fat necrosis in the needle tract of the depot antigens, as does the injection of 0.2 cc. of air after the dose.

Fluid toxoids and saline-suspended vaccines are usually injected subcutaneously, and depot antigens deep subcutaneously or intramuscularly.

Precautions and Contraindications

Acute infection, evidence of cerebral damage, poliomyelitis outbreaks, eczema and severe reactions to previous immunizing injections are situations which contraindicate or require especial precaution in the use of immunizing agents.

An acute infection in the child is reason to defer injection until the subsequent visit or until the infection is properly controlled.

Infants with evidence of cerebral damage may have severe reactions from combined antigens. It is recommended that immunization procedures be delayed in such infants until after one year of age and that then single antigens be used. A small test dose (one tenth of advised

dose) should be tried, and, depending on the reaction, four or more fractional doses at monthly intervals may be used. Acetylsalicylic acid and phenobarbital in appropriate dose should be given with each injection in such infants. Since pertussis vaccine may on rare occasion produce convulsions and encephalopathy,[21, 107] the question of whether to immunize against pertussis in the child with convulsive disorders has been debated.[34, 79] Most authorities now believe, however, that the risk of pertussis to such a child is greater than with the use of pertussis vaccine. Pertussis vaccine should not be used as therapy in treatment of whooping cough because it is of no value and some children become hyperreactive to pertussis antigens and respond with high fever and other alarming systemic symptoms.

The parenteral injection of depot antigens and possibly smallpox vaccination[53] should be deferred during a poliomyelitis epidemic. (Poliomyelitis vaccination of all unvaccinated persons under 40 is indicated under similar conditions; see section on Passive Immunity.) Depot type antigens apparently may cause localization of paralysis if injected within the month[3, 52, 73] preceding onset of poliomyelitis.

The recommendations in the 1957 Report of the Committee on the Control of Infectious Diseases of the American Academy of Pediatrics[98] are as follows:

> The occurrence of an outbreak of poliomyelitis in one's community is a signal for deferring elective immunization procedures. Local health officers should be consulted for an expression of opinion as to whether an actual outbreak of poliomyelitis exists or is threatened. Primary immunizations and/or recall injections obviously cease to be elective procedures when outbreaks of diphtheria, pertussis, typhoid, or smallpox co-exist with that of poliomyelitis.

The administration of poliomyelitis vaccine during a poliomyelitis outbreak is safe in that it has not been shown to provoke localized paralysis; however, such vaccination offers no immediate protection.[19, 95, 98]

Infants or children with eczema, other forms of dermatitis or any extensive wounds or burns should not be vaccinated against smallpox, to avoid generalized vaccinia or secondary takes which may occur in the denuded areas. The injection of hyperimmune vaccinia gamma globulin in the eczematous infant or child before smallpox vaccination may prove useful in individual instances as in smallpox outbreaks or before overseas travel[60] (see Table 8). Household contacts of children with eczema should not be vaccinated because of the danger of cross infection and subsequent eczema vaccinatum in the eczematous child. Such persons should be vaccinated only if removed to another household strictly separated from the eczematous child for a period of 10 days after vaccination.

The occurrence of reactions to an antigen in the form of high fever

(over 102° F.), local reaction, somnolence or convulsions is cause for caution in subsequent injections. If only a mild fever or local reaction occurred, the next dose should be reduced to one half or one quarter of the full dose. If a severe reaction or convulsion occurred, the next injection should be deferred for three months, and then fractional doses (0.05 to 0.1 cc.) of single antigens should be used individually as test doses and immunization completed slowly, using these preparations as indicated. Acetylsalicylic acid and phenobarbital in proper doses would be indicated.

Encephalitis is associated with smallpox and rabies vaccination procedures.[77] After smallpox vaccination the incidence of encephalitis is approximately 1:100,000.[115] It is rare under one year of age and has its highest incidence among children five to 15 years of age.[23] With the use of Semple vaccine for rabies the incidence of encephalomyelitis has varied from 1:600[87] to 1:9000.[75]

The occasional skin ulceration and local lymphadenitis which follow BCG vaccination for tuberculosis have healed satisfactorily.[71]

ROUTINE COMBINED IMMUNIZATION PROCEDURES FOR INFANTS

A schedule for active immunization procedures for infants is outlined in Table 6. In the usual infant a combined depot preparation containing alum or aluminum phosphate-precipitated or aluminum hydroxide-adsorbed diphtheria and tetanus toxoids containing *H. pertussis* vaccine would be administered in three doses. These would be commenced at one to two months of age and given at monthly intervals. Delay of up to three to six months between doses does not interfere with final immunity.[98, 109] Poliomyelitis vaccine would be injected at five to six months, seven to eight months, and 14 to 15 months of age. If the seven month interval between the second and third injections spanned the poliomyelitis season, it would be advisable to give the third injection just prior to the expected season. Poliomyelitis vaccine may be injected concurrently with the depot antigens if preferred. If this is done, the two injections should be given in separate syringes at different sites.[98] Combined preparations of poliomyelitis vaccine and triple antigens are on clinical trial and soon may be commercially available,[98] after which separate poliomyelitis vaccination may be omitted from Table 6.

Smallpox vaccination would be done one month after the completion of the triple antigen and poliomyelitis vaccine injections. Recall or booster injections outlined in Table 6 would include triple antigen boosters at age 18 months and four years of age. After five years of age triple antigen is not advised, owing to the increasing incidence of reactions. At eight years of age standard diphtheria-tetanus toxoid, either

depot or fluid, 0.1 cc. subcutaneously or intramuscularly, would be given, and then the new "adult" type of diphtheria-tetanus toxoid containing 2 Lf. (limit of flocculation) of diphtheria toxoid and 5 to 15 Lf. of tetanus toxoid would be given at age 12 and repeated every four years.

If this schedule were used, it would be unnecessary to do diphtheria toxoid sensitivity tests (Moloney or Zoeller), owing to the low incidence of reactions when only 2 Lf. of diphtheria toxoid are used.[16, 39, 40, 41, 98] Some clinicians prefer to do Schick tests as outlined in Table 6 and then use only routine tetanus boosters unless the Schick test is positive.

SITUATIONS DETERRING THE ROUTINE IMMUNIZATION SCHEDULE

A local outbreak of pertussis creates a problem requiring special attention to immunization. Newborns and unvaccinated infants in a household where pertussis is present should receive passive immunization followed by active immunization.

If no known exposure has occurred, rapid protection against pertussis should be attempted. Three subcutaneous doses of 4 N.I.H. (National Institute of Health) units (0.5 cc.) of saline-suspended *H. pertussis* vaccine should be injected at weekly intervals and followed with the required course of triple antigen, owing to the poor duration of immunity from the rapid immunization. Diphtheria outbreaks would also be an indication for rapid protection of susceptible infants and children. With the fluid toxoid, three injections of 0.5 to 1.0 ml. should be injected at 10 day intervals.

In either pertussis or diphtheria outbreaks an alternate plan for primary immunization of susceptible infants or children would be to use the combined fluid toxoids of diphtheria and tetanus and *H. pertussis* vaccine, giving three injections (0.5 cc.) at 10 day intervals followed by a fourth injection three months later.

A smallpox outbreak or anticipated travel to an endemic area would be an indication to vaccinate for smallpox promptly and before the course of triple antigen.

Local poliomyelitis outbreaks are an indication to give rapid immunization with Salk vaccine to susceptible children; however, in specific instances human immune serum globulin (gamma globulin) (0.14 cc. per pound) may be indicated, followed by a course of poliomyelitis vaccine.

PRIMARY IMMUNIZATION OF CHILDREN NOT IMMUNIZED IN INFANCY

A number of children in the United States are not immunized because of economic and other reasons such as migratory work of the

parents.[109] Children under five years of age may be immunized with depot triple antigen, using three doses of 0.5 cc. intramuscularly at four to six week intervals. A severe reaction to any dose would be an indication to complete the course with separate antigens.

In children over five years of age single antigens or the diphtheria-tetanus combination are preferred. The use of pertussis vaccine at this age is probably not necessary.

SEPARATE IMMUNIZATION PROCEDURES

Diphtheria

In children in whom the triple antigen preparation or the combined diphtheria-tetanus toxoids are contraindicated, the alum-precipitated or aluminum hydroxide-adsorbed diphtheria toxoid may be used. Three intramuscular injections of 0.5 cc. at intervals of four to six weeks give good immunity (over 0.03 antitoxic unit) for at least one year and fair immunity for a longer period.[32, 48, 114] Booster injections of 0.25 to 0.5 cc. of a depot antigen are advised 12 to 18 months after the primary course and then at three to four year intervals during childhood to maintain an adequate level of protection. Booster injections of the fluid antigen are recommended after exposure to diphtheria in children under 10 years of age and give a rapid antibody response.[37] Although booster injections of diphtheria toxoid have been used in high school students[57] and young adults[89] without previous Schick or toxoid sensitivity tests, this is not advised in standard doses (0.1 cc.) after 10 years of age. Fractional doses of 0.01 to 0.02 cc. of fluid diphtheria toxoid or 0.5 cc. of the "adult" type of diphtheria-tetanus combined toxoids could be used if Schick and toxoid sensitivity tests were not feasible.[39, 40, 41, 56]

Since diphtheria toxoid may cause reactions in those over 10 years of age, elective immunization of such persons should be preceded with a Schick test and toxoid sensitivity test (Moloney or Zoeller). Those with a positive Schick test and negative toxoid sensitivity test may be immunized with standard doses of three 0.5-cc. injections at four to six week intervals. Those who show positive reactions to both Schick and toxoid sensitivity tests are probably immune, and it is not necessary or safe to give the usual doses of toxoid. The Schick and toxoid sensitivity tests are both antigenic stimuli, and no further injections are usually required, although if the Moloney test was only moderately positive, 0.05 ml. of fluid toxoid could be given initially and, if no marked reaction followed, the dose could be doubled and injected at four weekly intervals until 0.75 cc. had been given.[102] Schick-negative persons, regardless of the toxoid sensitivity test, require no diphtheria toxoid.

Pertussis

The efficacy of *H. pertussis* vaccines has been established.[11, 78] Approximately 90 per cent of properly immunized children retain their immune status for two to two and one half years.[78]

Pertussis vaccine, saline-suspended as a single antigen, is used for rapid immunization of young infants born during a local epidemic of whooping cough and for older infants and children in whom the combined antigens are contraindicated. The alum-precipitated or aluminum hydroxide-adsorbed *H. pertussis* vaccines are also available and are indicated for immunization of infants and children who have already received diphtheria and tetanus immunizations.

An immunizing course of vaccine is standardized to contain 12 N.I.H. units as determined by a mouse potency test and must contain not more than 96,000 million killed organisms per immunizing dose of a fluid vaccine or 48,000 million in an alum-precipitated or aluminum hydroxide-adsorbed vaccine.

The primary course of either fluid or depot types of pertussis vaccine consists of 12 N.I.H. units divided into three doses of 4 N.I.H. units (0.5 cc.) injected intramuscularly at intervals of four to six weeks. For rapid immunization the injections of the fluid vaccine are made subcutaneously and the interval between doses reduced to one week.

Booster injections of fluid or depot type of antigens, consisting of 4 N.I.H. units (0.5 cc.), are given one to one and one half years after the primary course and every three years until entry into school. Boosters after this time are not usually recommended.[10, 71, 98]

Tetanus

The excellence of tetanus toxoid as an immunizing agent was illustrated in World War II.[96] In the United States Armed Forces personnel who were routinely immunized with tetanus toxoid and given wound boosters of toxoid and no tetanus antitoxin, only 16 cases of tetanus occurred in over 2,700,000 injuries.[70]

In comparison, German and Japanese troops who were not routinely immunized had frequent tetanus infections.[29, 70]

After a primary immunization course the protective level of 0.1 antitoxic unit in the serum persists for one year and is followed by nine years or more of greater than 0.01 antitoxic unit, which is partially protective.[15, 39, 93, 108] Routine recall injections produce adequate levels of antitoxin if given as long as 10 years after the primary series.[35, 93] However, wound boosters given more than four years after a primary course, without intervening booster shots, may not produce a satisfactory antitoxin level within the incubation period of some cases of severe tetanus. No remarkable antitoxic immunity is produced by the natural

disease,[25] and all tetanus patients should be actively immunized after recovery.

For primary immunization the alum-precipitated or aluminum hydroxide-adsorbed tetanus toxoid is recommended, owing to the more prolonged immunity. Two deep intramuscular injections of 0.5 ml. of these depot antigens at an interval of one to three months are sufficient. A booster injection of 0.5 cc. of depot toxoid is advised one year after the primary course and then 0.5 ml. intramuscularly every four years and at the time of injury. Fluid toxoid has been used for wound boosters; however, the U.S. Navy and Marine Corps have used depot toxoid for wound boosters with no morbidity from 1950 to 1953.[9] When routine boosters are given every four to five years, there is no need for tetanus antitoxin at the time of injury. However, if an injured person has not had tetanus toxoid for more than eight years and the injury is extensive or if 48 hours have elapsed, it is advisable to give both tetanus toxoid, 0.5 ml. intramuscularly, and 1500 units of tetanus antitoxin. For injured patients not properly actively immunized, see section on passive immunization.

Smallpox

Smallpox vaccination remains one of the most effective and important means of preventing disease. The efficacy was illustrated recently in the New York outbreak of 1947 and in the Korean incident.[71, 115] In areas of endemic smallpox yearly successful vaccination is required for complete protection.[71, 98] In the United States primary vaccination is advised during the first year of life with revaccination every five years or before foreign travel or in the event of a smallpox outbreak.[13, 72]

The multiple pressure techniques of vaccination using calf lymph virus is recommended. Sites for vaccination are over the left deltoid or triceps muscles high on the arm. Skin preparation using soap and water followed by acetone or ether is advised. After vaccination the excess lymph is wiped off with dry sterile cotton and the site allowed to dry. No dressing is used, and the site is kept dry until the scab falls off. Four gradations of reactions to vaccination occur: The *primary* vaccination or "take," in which the maximum diameter of the areola occurs at eight to 10 days, indicates that the person has no immunity. The *vaccinoid* or accelerated reaction, in which the maximum diameter occurs in four to seven days, indicates partial immunity. The *immediate* or *early* reaction, which reaches its maximum in two to three days, indicates immunity if the vaccine is of known potency, but also may indicate skin sensitivity if a dead vaccine is used.[12]

The failure of primary vaccination of a young infant to produce any reaction is usually due to either dead vaccine or interference of ma-

ternal antibody. Repeat vaccination at eight to 12 months of age using fresh vaccine is indicated. Repeated failures at revaccination of previously successfully vaccinated persons is an indication to try the other arm or the flexor surface of the forearm.

Poliomyelitis

The safety and efficacy of Salk-type poliomyelitis vaccine are now well established.[44, 67, 68, 100] The questions of how vaccination with this material will affect the occurrence of subsequent unapparent poliovirus infections, the duration of immunity to paralytic disease and the optimum time for booster injections remain to be answered.[90] Reactions to the vaccine have been rare, and no problems of sensitization to monkey kidney protein or Rh antibodies have been encountered.[1, 14, 68] Some of the current vaccines may contain trace amounts of penicillin and streptomycin; however, reactions attributed to these have been infrequent.[14] The primary course of immunization is discussed above, and the need and schedule for recall injections cannot be stated at this time.

Tuberculosis

Recent well controlled studies have further established the efficacy of BCG vaccine against primary tuberculosis infection.[2, 33, 42, 88, 97] The duration of immunity is unknown, but is probably approximately five years.

BCG vaccination is not recommended for all infants and children, but only for select groups of tuberculin nonreactors such as newborn infants whose parents have tuberculosis or infants and children in population groups having high tuberculosis morbidity rates.

Full term newborns who would be exposed to active cases of tuberculosis may be vaccinated at 24 to 48 hours of age without preliminary tuberculin testing if they have not been exposed to a case of tuberculosis. Placement in a tuberculosis-free foster home for two months is advised.

For other infants and children a negative tuberculin test and chest x-ray should precede vaccination. The intracutaneous method using 0.1 mg. of BCG vaccine contained in 0.1 cc. is usually recommended. If the tuberculin test remains negative after 12 weeks, revaccination may be done.

Typhoid and Paratyphoid Fevers

Triple typhoid vaccination is one of the few immunization procedures which have lost esteem in recent years.[71] Reports of typhoid fever occurring in recently immunized military populations have cast

doubt upon its efficacy.[5, 81] On the other hand, during the Korean incident the rate of typhoid fever in the United States Armed Forces compared to that of enemy prisoners would indicate a degree of effectiveness,[71] as do recent experimental studies.[27a]

Triple typhoid immunization is not routinely recommended for all infants or children, but only for those who may be exposed in epidemic areas. In infants under one year of age the total dose of 1.0 cc. should be divided into four injections of 0.2 cc., 0.25 cc., 0.25 cc., and 0.3 cc. injected at one to four week intervals. In older children the total dose of 1.5 cc. may usually be given in three subcutaneous injections of 0.3 cc., 0.6 cc., and 0.6 cc. Booster injections consist of 0.1 cc. injected intradermally every one to three years.

SPECIAL ACTIVE IMMUNIZATION PROCEDURES

Increasing international travel of families has caused many infants and children to require a number of special immunization procedures not frequently used in this country, but required in certain foreign countries.[71, 98, 102]

Influenza and mumps vaccines are of uncertain value in children and are not routinely recommended,[98] but are useful under certain circumstances.[50a] Rabies vaccine as well as antirabies serum is recommended under certain circumstances following animal bites[6, 54, 71, 98] (see also Table 8).

Table 7 is a summary of the currently recommended doses for these special active immunization procedures.

PASSIVE IMMUNIZATION PROCEDURES

A number of passive immunization procedures are of value in preventing disease if administered prior to the disease or early in the incubation period.

Diphtheria

Exposed persons should have nose and throat cultures taken, have a Schick test, and receive penicillin.

Diphtheria antitoxin should be administered to exposed contacts who have a positive throat culture and positive Schick test. Most persons with properly spaced primary immunizations and boosters will be Schick negative and require only an exposure booster. The dose of diphtheria antitoxin is 5000 units.

Infectious Hepatitis

Children and adults exposed to infectious hepatitis (IH) who have not had the disease should receive human immune serum globulin

TABLE 7. *Special Active Immunization Procedures*

VACCINE	DOSAGE BY AGE (CC.)				NO.	INTERVAL	RECALL
	2 mos.–2 yrs.	*3–6 yrs.*	*7–10 yrs.*	*>11 yrs.*			
Epidemic typhus	0.12	0.25	0.5	1.0	3	1–3 weeks	Same as initial dose of each series annually p.r.n.
Cholera or Plague:							
1st dose	0.06	0.12	0.25	0.5		Children, 7–10 days	Same as initial dose of each series; 6 mos.–4 years
2nd dose	0.12	0.25	0.5	1.0		Adults, 7 days for cholera; 7–28 days for plague	
3rd dose	0.12	0.25	0.5				
Typhoid-paratyphoid:							
1st dose	0.2		0.3				0.1 cc. I.D. every 1–3 years
2nd dose	0.25		0.6				
3rd dose	0.25		0.6				
4th dose	0.3		—				
Influenza	Before exposure 1.0				1		Annual(?)
Mumps	Before exposure 1.0				2	1–4 weeks	6–12 months
Rabies (Sempel) (avianized)	After exposure 2.0 After exposure 1.0				14–21 daily		After exposure if re-exposed
Tuberculosis	24 hrs. plus if skin test negative: 0.1 mg. of BCG in 0.1 cc.				14 daily 1		None
Yellow fever	0.5 cc. S.C. for all age groups over 6 months of age of a 1:10 dilution of concentrated vaccine (at U.S. Pub. Health Ser. Substations)				1		0.5 cc. after 6 years or in presence of epidemic

(gamma globulin). If such is given early in the incubation period, effective passive immunity can be obtained from doses as small as 0.01 to 0.02 cc. per pound.[50, 103]

Serum hepatitis (SH) is transmitted by the parenteral inoculation of blood or blood products containing the hepatitis B virus. Passive immunization for serum hepatitis is of uncertain value and is not recommended.

Measles

Two degrees of passive immunization are recommended for susceptible infants and children exposed to measles.[10, 58] An attempt should be made to prevent the disease using a large dose of human immune serum globulin (0.1 cc. per pound) in infants under one to two years of age, in chronically ill children and possibly in healthy children whose siblings are ill with tuberculosis, rheumatic fever or pertussis.

In other children and adults a smaller dose of human immune serum globulin (0.02 cc. per pound) should be used in an attempt to modify the disease. In either instance the passive antibody should be given prior to six days after exposure, since after this time even double doses are of uncertain value.

Mumps

Passive immunization of exposed children is usually not recommended; however, adults with no history of mumps may receive temporary protection by the use of human hyperimmune mumps gamma globulin.[45] A skin test for mumps susceptibility should be performed; if this is negative, 2.5 to 5.0 cc. of hyperimmune gamma globulin may be administered.

Pertussis

Susceptible infants under two years of age who are intimately exposed to pertussis should receive one of three available immune serums.[17, 69, 74] These serums are 70 to 80 per cent effective in preventing pertussis if given early in the incubation period.

Poliomyelitis

The effectiveness of gamma globulin in passive immunization against poliomyelitis is well established, provided it is given early; however, in practice its use has been controversial.[49, 84, 101] The biostatistical summary of the use of human immune serum globulin for the prevention of paralytic poliomyelitis in 1953 indicated a 50 per cent effectiveness.[84] Salk-type poliomyelitis vaccine is not immediately effective when used under epidemic conditions.[19, 95] Therefore, under certain conditions when an unvaccinated person receives a definite exposure, 0.14 cc. per pound of human immune serum globulin may be given followed by active immunization.

TABLE 8. *Indications for Specific Postexposure Treatment*

NATURE OF EXPOSURE	CONDITION OF ANIMAL		RECOMMENDED TREATMENT
	At Time of Exposure	During Observation Period of 10 Days	
I. No lesions Indirect contact only	Rabid		None*
II. Licks			
1. Unabraded skin	Rabid		None*
2. Abraded skin and abraded or unabraded mucosa	(a) Healthy	Healthy	None
	(b) Healthy	Clinical signs of rabies or proved rabid	Start vaccine at first signs of rabies in animal
	(c) Signs suggestive of rabies	Healthy	Start vaccine immediately. Stop treatment if animal is normal on 5th day after exposure†
	(d) Rabid, escaped, killed or unknown		Start vaccine immediately
III. Bites			
1. Simple exposure	(a) Healthy	Healthy	None
	(b) Healthy	Clinical signs of rabies or proved rabid	Start vaccine at first signs of rabies in animal
	(c) Signs suggestive of rabies	Healthy	Start vaccine immediately. Stop treatment if animal is normal on 5th day after exposure†
	(d) Rabid, escaped, killed or unknown; or any bite by wolf, jackal, fox or other wild animal		Start vaccine immediately
2. Severe exposure (multiple; or face, head or neck bites)	(a) Healthy	Healthy	Hyperimmune serum immediately. No vaccine as long as animal remains normal
	(b) Healthy	Clinical signs of rabies or proved rabid	Hyperimmune serum immediately, but start vaccine at first sign of rabies
	(c) Signs suggestive of rabies	Healthy	Hyperimmune serum immediately, followed by vaccine. Vaccine may be stopped if animal is normal on 5th day after exposure
	(d) Rabid, escaped, killed or unknown. Any bite by wild animal		Hyperimmune serum immediately, followed by vaccine

Hyperimmune serum to be effective must be given within 72 hours of esposure; dose, 0.5 ml./kg. of body weight.
These indications apply equally well whether or not the biting animal has been previously vaccinated.
* Start vaccine immediately in young children and patients when a reliable history cannot be obtained.
† Alternative treatment would be to give hyperimmune serum and not start vaccine as long as animal remained normal.

TABLE 9. *Summary of Passive Immunization Procedures*

DISEASE	DESCRIPTION	DOSE	COMMENT
Diphtheria	Diphtheria antitoxin	5000 units I.M.	After exposure if throat culture positive and Schick test positive
Infectious hepatitis	Human immune serum globulin (G.G.)	0.01–0.02 cc./lb., I.M.	Repeat in 4–6 weeks if re-exposed
Measles	Human immune serum globulin (G.G.)	0.1 cc./lb., I.M.	To prevent the disease in infants and debilitated children
		0.02 cc./lb., I.M.	To modify the disease for all other children
Mumps	Human hyperimmune mumps gamma globulin	2.5–5.0 cc. I.M.	For adults with negative mumps skin test and no previous history of mumps
Pertussis	Human hyperimmune pertussis serum	10.0–20.0 cc. I.M.	2 doses, 5–7 days apart
	Human hyperimmune pertussis gamma globulin	2.5 cc. I.M.	2 doses, 5–7 days apart
	Rabbit hyperimmune pertussis serum	20,000 units I.M.	2 doses, 3 days apart
Poliomyelitis	Human immune serum globulin	0.14 cc./lb., I.M.	Total dose 10–20 cc.
Rubella	Human immune serum globulin	0.1 cc./lb., I.M.	Preferably total dose should be composed of 2 or 3 different lots
Tetanus	Tetanus antitoxin	<15 kg., 1500 units S.C. 15-30 kg., 3000 units S.C. >30 kg., 5000 units S.C.	For wounds treated after 24 hours use 5000 units. Repeat first dose in 1 week if wound not healing
Smallpox	Human hyperimmune vaccinia gammia globulin	0.3 cc./lb., I.M.	Obtained from C. H. Kempe, M.D., by special arrangement, University of Colorado, Medical Center, Denver 20, Colorado—Dudley 8-4511

† Alternative treatment would be to give hyperimmune serum and not start vaccine as long as animal remained normal.

Rabies

The recently developed hyperimmune rabies antiserums have proved effective in experimental rabies and in clinical use.[6, 54, 55, 61, 62] Table 8 summarizes the indications and recommended procedures for rabies vaccine and hyperimmune antirabies horse serum prophylaxis.

Rubella

The "rubella problem" persists for pregnant women of unknown susceptibility exposed during the first trimester.[64] The problem is individual for each married couple, owing to personal and religious considerations. The value of human immune serum globulin is uncertain, but since different lots vary in effectiveness,[63] it would be well to divide the total dose (10 to 20 cc.) between two or three different lots.

Tetanus

Children with contaminated wounds who have not been immunized with two or more doses of depot tetanus toxoid or three or more doses of fluid toxoid should receive tetanus antitoxin after a test for horse serum sensitivity. The efficacy of tetanus antitoxin for preventing tetanus has been proved,[99] but is inferior to active immunization.[95] The recommended doses of tetanus antitoxin are outlined in Table 9. The administration of heterologous antiserum refined by modern methods is followed by a significant number of allergic reactions.[83, 96] For this reason active immunization with booster shots is preferable. It protects against those cases which are not preceded by any known injury and also those persons who received previous horse serum injections.[60a]

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ACCIDENTS, INJURIES AND CHILDREN

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In the time it has taken you to read the title of this article, one child in the United States has been injured in an accident. In the next four minutes another child will have been left permanently injured or crippled by an accident. In the last 40 minutes one child has died as a result of an accident. Startling! you say. Yes, but this is only part of the story. Accidents have become the leading cause of death in children between the ages of one and 15 years. Among school-age children dying in 1954 one half of all the boys and one fourth of all the girls were the victims of accidents. During 1955, 14,500 children under 15 years of age were killed in accidents in the United States.[1] For each child killed at least 10 children are permanently disabled by accidents, and it has been conservatively estimated that for each death there are at least 100 additional children injured in accidents.

Deaths from accidents have been reduced over the past few years (Fig. 1), but the rate of reduction of death from accidents is only about one third of the rate of reduction of the other main causes of death (Fig. 2). In Ohio in 1955 the deaths due to accidents alone equaled the total deaths from tuberculosis, pneumonia, infective and parasitic diseases and heart disease together.*

Any illness which killed this number of children annually would receive the immediate attention of every physician, yet the consideration that this Number One child killer has received has been extraordinarily slow in coming, especially in comparison with its magnitude. If we look for reasons for the apathetic response to the problem created by accidents, the enormity and complexity of accident occurrence, leading

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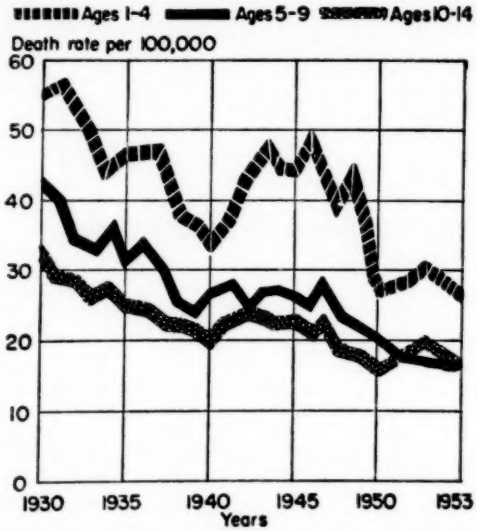

Fig. 1. Trend in fatal accident rates, 1930–53. (Used with permission of Wheatley and Kasey, Metropolitan Life Insurance Company, New York City.)

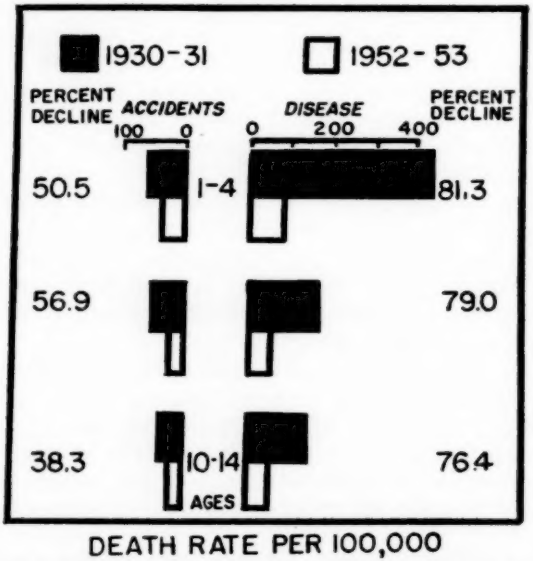

Fig. 2. Decline in accident rates compared to disease. (Use with permission of Wheatley and Kasey, Metropolitan Life Insurance Company, New York City.)

to a feeling of hopelessness, appear to be the most important. But this problem need not be regarded as insurmountable. There is a time when and a place where accidents occur, and there is a decided age and sex predisposition to accidents. Certainly there are clear-cut reasons for accidents. Let us examine them.

EPIDEMIOLOGY

Here are some of the facts which may throw some light on this complex problem. Boys are far more apt to be involved in accidents than girls. Actually the ratio is at least 2 to 1 as recently confirmed in a study by Smid and Logan at the Mayo Clinic.[14] This study also re-emphasizes

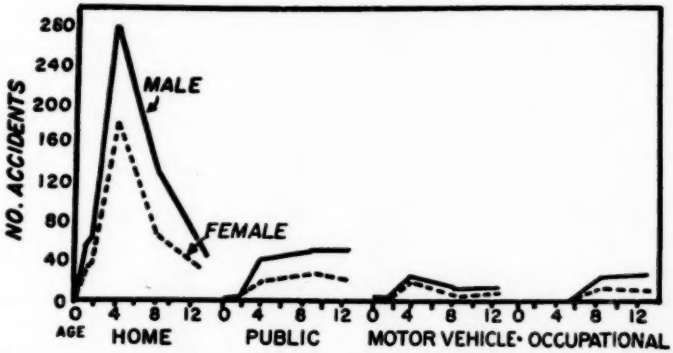

Fig. 3. Incidence of accidents according to locality and age group, from a study at the Mayo Clinic. (Adapted from A. C. Smid and G. B. Logan: *Minnesota Medicine*, Vol. 39. Used with permission of the authors.)

the fact that most accidents occur in the home (Fig. 3). It is interesting that the two most dangerous rooms of the home are the bedroom and the kitchen. Smid and Logan point out once more and quite graphically the decidedly greater incidence of accidents in the two to five year age group. Yet these are the children one usually thinks of as being most closely supervised by parents, and the ones whose health is most closely followed by family physicians and pediatricians. If one were to concentrate on reducing deaths and disability from accidents solely in this preschool age group, in which the physician-family relationship is strongest and the environment least complex, the total incidence of accidents would be reduced significantly.

Even the time of day and the season of the year play an indirect role in the causation of accidents.[10] More accidents occur in the late afternoon than at any other time of the day. Those of you with children can certainly attest to the fact that this is the time of day when chil-

dren are the most tired and restless and are most likely to take unnecessary risks. As might be expected, the greatest incidence of accidents occurs during the summer months, when children are playing outdoors and are left relatively unsupervised.

ETIOLOGY

The leading causes of accidents can be determined by studying two kinds of material: (1) accidental causes of death as reported on death certificates; (2) surveys of injuries reported from physician's offices, from

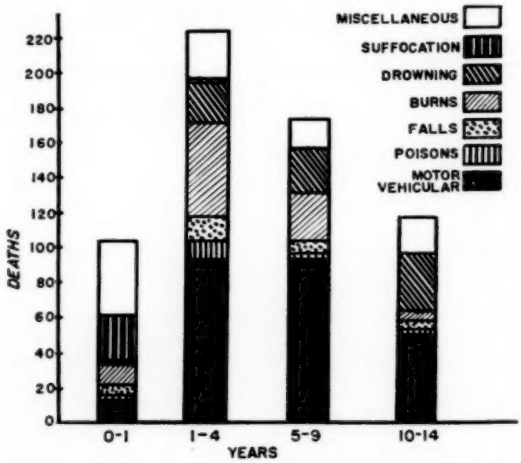

Fig. 4. Causes of death in Ohio in 1955. (From information supplied by the Division of Vital Statistics, State of Ohio.)

emergency rooms or from hospital admissions. Numerous studies of both types are available in the literature.[7, 10, 12, 13, 14, 18]

The main causes of accidental death by age group in Ohio in 1955 are depicted in Figure 4. Note that the main cause of accidents under one year continues to be reported as *mechanical suffocation*. The validity of this diagnosis, in the majority of instances, is open to question. The deep-seated feeling of guilt, because of the implied neglect, which parents have in such a tragedy should be quickly dispelled if at all possible. In situations in which the diagnosis of mechanical suffocation would be likely to be made and in which autopsies have been done, a natural cause of death has usually been discovered.[2, 3, 16] The most common pathologic diagnosis made in such instances is interstitial pneumonia. Physicians should therefore attempt diligently to obtain permission for autopsies in all cases of sudden, unexplained death.

After the first year of life motor vehicular or *traffic accidents* become the main cause of death among children. Next in frequency as causes of fatalities come burns, drownings, falls and poisonings.

In a study of accidental injuries among children 16 years and younger in the greater New Bedford area in Massachusetts in 1955 Rice, Starbuck and Reed[12] reported the following percentage of accidents among 1861 cases: falls, 39 per cent; impact (collision or blow), 29 per cent; cutting and piercing injuries, 12 per cent; bite, 6 per cent; swallowed poison, 5 per cent; burns, 3 per cent; crushing, 3 per cent; foreign body, 2 per cent. The disparity between statistics of fatal accidents and data on reasons for accidental injuries is obvious and must be taken into account. For example, burns are responsible for relatively few accidental injuries, but because burns in children are often extensive and deep, this type of injury ranks second as a cause of death.

Injuries from *falls* commonly occur in accidents involving a fall from one level to another, such as a fall from a window, from a fire escape or from stairs. It is important, then, that stairs be guarded with gates or railings, that windows be protected with strong screens or bars and that fire escapes have adequate railings. In the home many injuries occur in seemingly simple falls as from a high chair, a sofa or a bed.

One needs to see only a few accidents to be impressed with the importance of *burns* as a cause of death or a permanently disfiguring scar. Matches carelessly left around the house are frequently picked up and lighted by exploring children. Unsuspecting toddlers pull containers full of hot liquids from stoves or tables. Familiar hot water faucets and showers are turned on full force with no expectation of the painful burn that might result.

The two year old who would rather be caught dead than be seen eating an egg or a bite of meat will gleefully chew up a bottleful of aspirin tablets, munch on a piece of lead paint or take a swig of kerosene or turpentine if any of these substances are in his field of operations. Stanage and Henske[15] found that medicines constituted the main source of *poisoning* in children, and furthermore, that the single, most common poison was our old stand-by, aspirin. This drug accounted for 16 per cent of all poisonings. The vast array of dosage forms and tablet sizes of aspirin, all of which are labeled as "children's aspirin," is confusing to mothers and doctors alike. But significant progress is being made in this particular field: Legislation to ensure standardized tablet size of aspirin is being sought. Manufacturers are being encouraged to develop containers which defy opening by children's inexperienced hands.[17]

Manufacturers were recently urged to describe, in brochure and package literature, the therapeutic dose, dosage level of serious toxicity, and symptoms, signs and treatment of massive overdosage.[9] Such informa-

tion is particularly needed in the case of new drugs. Since medicines account for such a high percentage of all poisonings, doctors are in a particularly advantageous position to exert some control over this type of accident.

Drownings account for a surprisingly large number of accidental deaths, ranking third in frequency after the first year of life. Tragically, most drownings in the first year of life occur when infants are left unattended in a bathtub for a few minutes while the mother goes to attend to something else. A child's fascination for water threatens him even more at later ages. A dive into an unfamiliar pond, a fall into an irrigation ditch or unprotected well or simply playing around in water beyond his depth kills all too many children.

PATHOGENESIS

Accidents in children occur as an interplay of numerous factors. One must be acquainted with these circumstances before beginning to plan a program of accident prevention. Chief among these factors are the following:

Developmental Level of the Child

As a child grows, his physical capabilities, his curiosity about his environment and his emotional adjustment to it are constantly changing. It is these very factors of inexperience, immaturity, curiosity and incoordination which make him so likely to incur an accident. It follows, then, that the age when the child is the most "un-learned" would be the time when he would have the most accidents—this coincides precisely with the facts as shown in Figure 1: the one through four year age group. Fortunately most of the mishaps during these early years are minor ones. But they are also valuable ones, for from these the child learns the rudiments of accident awareness and self-protection.

Dietrich[5] has pointed out that the early months of life (from birth to one to one and a half years) represent a time when children must be completely protected from dangers. Accident prevention at this age takes the form of physical restraint of the child and keeping dangerous objects away from him. But some time after the first year the child's ability to ambulate and his natural inquisitiveness make him more susceptible to injury. At this time, however, another wonderful trait appears—he becomes educable. Minor accidents at times may even be allowed purposely so that a lesson in danger awareness can be taught. For example, the child who is unmindful of the danger of touching a hot pan or oven might be allowed to touch it, if it were not too hot, in order to learn the association of heat and pain. Such a lesson is espe-

cially forceful if he has been told beforehand, "The pan is *hot*; it will *burn*; it will *hurt!*" And, strangely enough, his estimate of his parent's wisdom may jump two notches because he had been warned that it was hot and that it would burn and because it really hurt! The lesson that one cannot breathe under water can be taught in a similar way: The puzzled expression on the two year old's face when he is allowed to walk beyond his depth in a pool and finds he cannot breathe is vivid evidence of a fundamental fact discovered.

Protection becomes gradually less necessary as these perceptions are gained, but education must be continued for years and must be suited to the interests and activities of the individual. As the child develops, the types of accidents most likely to occur change, for example, from the falls incurred while he learns to climb to the poisonings resulting from his insatiable curiosity about how things taste. Obviously the physician, with his knowledge of the normal growth patterns of children, is in the best possible position to forewarn parents about the accidents which might be expected at any particular age and about preventive measures which others have found effectual. This leads directly to the second main factor in the cause and prevention of accidents.

Parental Attitudes toward Accident Awareness and Prevention

"Just as the twig is bent, the tree's inclined" holds true for attitudes toward accidents as well as for other parental views which children adopt. When children see their parents take unnecessary risks, they assume that this is the norm to copy. As Wheatley points out,[18] the adult possesses safety habits and attitudes which are well established, but not inflexible. It is one's responsibility in dealing with children to try to think of accident hazards on the particular level of the child. This, then, involves forethought on the part of the parent, Dietrich[4] states, and this is the first step in "immunizing" children against accidents. But attention to the kinds of danger to look for is worthless without taking the time to point them out at every opportunity. This time which must be taken is the second step.

And this implies the third step—repeated, consistent, firm but kind parental discipline which makes certain that few if any opportunities are missed for bringing home these lessons. Once more here the physician in his routine contacts with the family is in the best position to warn and thus arm the parent in advance of accidents. Teaching parents about children's accidents does not differ essentially from helping parents to comprehend the need for immunizations and proper food and rest and to understand the pattern and normal range of children's growth and development. All these, including accident prevention,

should be part of the health supervision of children, shared by parents and their physicians.

It would be a mistake simply to alarm parents by telling them that accidents are a "big problem" and that precautions must be taken to avoid them. Anxieties about accidents lead to overprotection of children and become obstacles to normal development. The most important part of the physician's advice is not the information that accidents are frequent and often serious in childhood, but the constructive help he can give to parents about preventing situations almost certain to lead to injuries. Most parents want to do the right thing for their children, and physicians can help them to be ready for any situation, without causing anxieties to develop.

Furthermore, physicians need to remember that some accidents are inevitable and that the margin between a minor misfortune and a disastrous accident is sometimes narrow and uncontrollable. The risk of establishing guilt feelings by unsympathetic discussion of responsibility for accidents should be guarded against by postponing inquiries into the cause of the accident until the immediate crisis has passed.

Parents need constructive help in assuming their part in preventing accidents. Advice should be given with tact and understanding. The whole subject of accident prevention should not be avoided, however, because of the occasional exaggerated emotional reaction of some parents. The medical profession has never considered abandoning immunizations against infectious diseases because children and some mothers are fearful of the procedure. Instead, there has always been an effort to avoid the undesirable responses as much as possible by explanations and understanding.

Accident-Proneness

Langford,[8] in his study of accident-proneness in children, describes the accident-prone child as being overactive and restless, impulsive, well liked by adults but not by his fellows, and as exhibiting a poor reaction to stress. Under stress he tends to become more impulsive and disorganized and seems to get himself into situations in which accidents are inevitable. More striking than these, however, was his observation that there was a decided tendency to repeated accidents in the entire family of which this child was a member. These families did not seem to be as closely knit as the nonaccident families and the child did not get his dependency and security satisfactions satisfactorily met at home. Still, whether accident-proneness is an important causative factor in accidents in children is open to a great deal of question. Langford's studies were conducted on small samples, and more work in this field is necessary. Jacobziner,[7] in a recent study, found that in 120 accidents,

careful analysis showed that 96 per cent of the children had definitely not been in previous accidents. He believes that accident-proneness was not a significant factor in the group of children under six years of age reported to him.

ROLE OF THE PHYSICIAN

The physician has the most important function in accident prevention. It is he who sees an injured child soon after an accident, and he is the one who can best initiate preventive measures to avoid a similar occurrence. One might hope that every physician recognizes the importance of the problem and his responsibility in solving it. At the grass roots level this service begins in the physician's own practice. The following constitutes an outline of some of the specific steps a practicing physician might follow in setting up an accident-prevention campaign in his own practice. The resourceful physician can add other measures to suit individual conditions.

Prescribing Drugs

It is certainly desirable (and economically advantageous to his patients) for the physician to prescribe only enough of a particular drug to last for the expected length of the illness.[6] Parents as a rule should be told the name of the particular drug being used, especially if it has unwanted side reactions or toxicity. The habit some parents have of keeping small remnants of medicine on the shelf in unmarked containers should be discouraged.

Physicians can be leaders in the organization of a *poison control center* in their community to reduce the harmful effects of poisons.[11] In many cities, by community action initiated by pediatricians and family physicians, there has been established in one of the hospitals on a 24 hour a day basis, a source of accurate information about the toxic ingredients in the more than 250,000 brand-name chemical products currently available for home, industrial and farm use. In addition to factual data about the constituent chemicals, up-to-date information is also available upon request about the first aid and medical treatment of poisoning.

It was announced in April, 1957, that a National Clearing House for Poison Control Centers has been established in the Public Health Service to facilitate collection of data from local centers and make available to the centers information about new products as well as the composite experiences of other control centers.*

* G. M. Wheatley: Personal communication.

Aspirin

This drug warrants a special warning, since it accounts for many poisonings in the pediatric age group. It would be difficult to say whether salicylate poisoning is due more to accidental ingestion of the drug or to overmedication. Specific directions about dosage and the need to force fluids during its use must be clearly outlined at the onset of medication in each illness. The dispensing of "fever pills" by physicians without the warning that they contain aspirin is dangerous and undesirable. All too many parents give aspirin *along with* such "fever pills," thinking that this will certainly "lick the fever." Standardization of the pediatric tablet size and the development of safety containers also should do much to remove this drug from its Number One position as a poisoner of children.

Developmental Level Hazards

The routine well-child visit to the physician offers the golden opportunity to talk with a mother about the kind of accidents likely to occur at the particular age level of her child. This certainly represents good preventive pediatrics and, like all preventive measures, is most effective when it serves to forewarn and forearm the parent. When the milestones of formulas, rashes, baths and toilet training have been passed, the mother is especially receptive to such new fields of endeavor as accident prevention. This coincides well with the most accident-prone age—the two to five year olds. This age group deserves special consideration for the many reasons already given. One might call attention specifically to the dangers of stoves, hot utensils, floor registers or furnaces, hot water taps, step ladders, yard gyms and electric outlets and the storage of household cleaners, polishes and insecticides. Mothers find check lists, supplied by their physician to help them "baby-proof" the house, especially helpful. This leads naturally to:

Literature in the Office

The busy practitioner can be saved a great deal of time by keeping a supply of accident-prevention pamphlets and check lists on hand in his office. They assume a great deal more importance if they are given to the parent by the physician himself as a part of his instructions for that visit. Of greatest value would be a check list or brochure prepared by the individual physician, his county Medical Society or his local Accident Prevention Committee. The following is not presented as an exhaustive list of reference material, but merely represents a few pamphlets which the authors have found useful:

1. *Check List against Child Accidents in and around Your Home*
2. *A Letter to Parents*
3. *A Formula for Child Safety*
4. *Caution, Babies Learning.*

These are available from the Metropolitan Life Insurance Company and are designed for use by parents. A guide for physicians, entitled *Three Is a Lucky Number,* is also available from this company. A complete list of source material on home and child safety can be secured from the Metropolitan Life Insurance Company.*

5. *Your Child's Safety:* Nationwide Insurance Companies, 246 N. High Street, Columbus, Ohio
6. *Safe at Home:* John Hancock Life Insurance Company, Boston, Massachusetts
7. The Equitable Life Assurance Society of the United States, 393 Seventh Avenue, New York 1, New York, will furnish material on accident prevention.

House Calls

Here is another good opportunity to observe and point out accident hazards in the home. In this connection it is also possible in some communities to have a public health nurse make a follow-up visit to the home after an accident, to point out hazards about the home and to help the parents avoid future trouble.

Crusader in the Community

The physician who takes an active interest in accident prevention in his own practice will be interested in reaching as many parents as possible. Accident prevention should be a subject for talks he gives to parent-teacher and child study groups. This offers him the opportunity to get his message across to a large number of parents at one time. The physician on the faculty of a medical school should see to it that some instruction in accident prevention is given to students. Other physicians can be interested through discussions at hospital staff meetings. The results of endeavors like these may not be as dramatic as a shot of penicillin, but they may well serve to stimulate others and help start a chain reaction.

COMMUNITY ROLE

Rice and associates[12] demonstrated what an aroused community can do in the way of accident prevention. His report of his community's job is in itself a blueprint for accident prevention at the community level. Though the physician's role is a primary, motivating one, the entire community must be interested and all possible facilities used to

* 1 Madison Avenue, New York 10, New York.

effect a worth-while prevention program. These authors emphasize that for maximum interest local statistics must be used in the program, that local committee men should be chosen particularly for their ability to get things done and finally that the move must be identified as the community's own problem. The results of such a campaign cannot be assessed solely on the basis of a decline in the death rate from accidents. The effectiveness of an accident prevention program should be measured in part by the amount of community action resulting from stimulation by the accident prevention committee.

SUMMARY

Accidents are now the main cause of death in the pediatric age group. Most of these accidents occur in the home.

The causes of accidents are discussed and the seeming disparity in groups of statistics reported as fatalities from accidents and those reported as morbidity are pointed out.

The various factors operative in the child and in his environment which interact to cause accidents are discussed.

The risk of creating anxiety and guilt in the parents by unwise counseling is brought out.

The physician's role in accident prevention, both in advising parents and as a leader in the community, is described.

An accident prevention program for the individual physician's private practice is outlined.

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CHILD HEALTH SUPERVISION

Importance in the Prevention of Handicapping Conditions

SAMUEL M. WISHIK, M.D.

Some conditions that lead to permanent disabilities are preventable; many others, within our present state of knowledge, are not. Among the latter the element of preventability lies in keeping the unavoidable condition from producing a permanent disability; for this the chief factor is prompt and adequate treatment. This clinic will not cover treatment, but will emphasize how, during the process of supervising the health of the supposedly well child, the physician can identify those incipient conditions that have potential for leaving a handicap. Although items have been chosen for presentation in the following pages only because they have preventive aspects, recognition of any abnormality in a child, even though it may be neither preventable nor correctable, offers occasion for parent interpretation, counseling and support which have strong preventive implications in terms of the child's management and subsequent adjustment. Interpretation to parents should begin early, need not necessarily be comprehensive at the start, but should meet their needs and readiness and, as soon as possible, should try to eliminate misunderstandings that might produce needless guilt and resentment.[1]

It is obvious from the earlier clinics in this volume that health supervision for preventive purposes starts well before birth. *Genetic* factors are important, and *prenatal* factors have already been given consideration and will not be covered here. Two other important features of health supervision have also been covered, immunization and accident prevention. Therefore only a few comments on these will be made for emphasis through repetition.

IMMUNIZATION

The chief indication for immunization early in infancy is protection against pertussis. Efforts by the pediatric profession to start immunizations as early as one month of age have thus far met considerable public and professional inertia. Not only is immunization not reaching the entire child population, but among those who are reached, many obtain the primary immunizations too late in childhood. The second rather general defect in immunization practices at present is the failure to give sufficiently frequent booster immunizations. In only a portion of the children who receive the primary immunizations are their immune titers being maintained during the preschool years. Surely, if the physician has not decided in his own mind what is a good schedule of booster injections, then the parents cannot be expected to conform to one.

ACCIDENT PREVENTION

Medical guidance of parents in the rearing of children cannot possibly be complete in this day and age if accident prevention and safety are not integral and ever-present parts of parent counseling. A physician who limits his advice to feeding, immunizations and behavior has omitted the item of discussion that might make the difference between the family's having or not having a child to feed, to immunize or to discipline. The shocking statistics on accidents as the leading cause of death in children after the first birthday and one of the leading causes even before the first birthday must be told over and over again to remind ourselves of this responsibility we have to fathers and mothers in our supervision of the health of their children. Education of parents on safety is probably most effective if it is given in respect to the specific ages of their children at the time. A knowledge of children's capacities, interests, tendencies and activities at different ages, as well as the frequency of different types of risk and of accidents, should determine the accident-prevention topics the physician discusses with parents.

HEALTH SUPERVISION

In his health supervision of a large number of children the physician does not give equal closeness of follow-up to all cases. In some, family, prenatal or neonatal history may indicate that there is greater chance of certain conditions developing later. For example, a small premature baby or one with a history of anoxia or convulsions in the neonatal period would be labeled in the doctor's mind, and preferably on his records, as "*vulnerable*" or "*susceptible*" and would be followed with particular care. Even such alertness often cannot prevent the condition

that is feared from occurring, but it does give the physician earlier basis for starting interpretation to the family so that they can adjust, and help their child adjust, to the realities of the situation. Giving guidance to the parents may well prevent an emotional disturbance that could be more serious than the physical condition which generated that disturbance.

In the span of health supervision of the child from birth through adolescence, there are three common occasions for detecting incipient conditions. These are (*a*) examination of the newborn infant, (*b*) health supervision of the child through infancy and the preschool years, and (*c*) supervision of the health of the child of school age.

Examination of the Newborn Infant

The newborn infant usually receives a first appraisal in the delivery room and a more complete examination in the nursery. Nevertheless, another thorough examination should be given at the time of discharge from the hospital even though this is a presumably "normal infant."

The routine examination of the newborn infant is a time to look backward for clues on hereditary or familial conditions and for prenatal episodes that may alert one to possible abnormalities. This is also the time for the most careful search for congenital malformations and birth injuries, some of which, once ruled out, need not be looked for thereafter. Some, on the other hand, may not make their presence evident until subsequent examinations. Among the conditions that might be detected at the time of examination of the newborn infant, four especially are here singled out because they are fairly common, because their immediate recognition is not a lifesaving measure as it would be with tracheo-esophageal stricture or intestinal obstruction, and because their early recognition and prompt treatment are possible and might help to prevent or reduce residual disability. These are raised angiomas of the face, birth injuries of the brachial plexus, foot abnormalities and posterior urethral valves. Another reason for particular emphasis before the baby leaves the hospital is the uncertainty about the time that may elapse before the child is brought back to the physician. Under favorable circumstances three or four weeks may elapse; commonly, critical months go by before the first return visit.

Facial Angioma. Very small, raised cavernous angiomas on the face are not uncommon. They may be entirely absent at the time of birth, only to appear several weeks later, or may be of pinpoint size and easily missed. Sometimes, however, they grow rapidly during the first days or weeks after appearance, but usually spontaneously cease enlarging after reaching between 0.5 and 2 cm. in diameter.

Not only does this type of nevus usually stop growing without treat-

ment, but also it often disappears spontaneously during later childhood, presumably by occlusion of the afferent vessel. Despite such good prognosis, the size and unsightliness of the permanent scar on the face after either spontaneous regression or treatment depend chiefly on the size of the lesion at its maximum. Therefore the finding of a small raised angioma on the face, even though pinpoint in size, at the time of discharge of the infant from the hospital warrants day-by-day observation of the lesion rather than waiting for the next routine visit to the pediatrician's office about one month of age or later. The lesion should be outlined on transparent plastic, such as a piece of x-ray film. The mother should place this over the hemangioma every few days and should immediately report any extension to the physician. The same concern need not apply when the hemangioma is on a part of the body where cosmetic defect would be less significant. Parents should be alerted, however, to watch for rapid enlargement, regardless of its location.

Brachial Paralysis. Brachial paralysis of one or another type is usually associated with an absence of Moro response and upper extremity movement on one side. Particularly with a history of breech delivery, special attention should be given to the spontaneous movements of the upper extremities.

Foot Deformities. The pediatrician should organize for himself a systematic procedure for examination of the feet of newborn babies. Only by knowing what normal feet look like in respect to position, flexibility and range of active and passive movement can he learn to spot the less gross deviations. The casual appraisal of the feet during the physical examination of the newborn can be little better than a layman's observation if the pediatrician does not get into the habit of making a sequence of objective observations in looking at the feet. An objective examination of the foot would answer the following questions: What is the spontaneous angle between the longitudinal axis of the foot and the axis of the leg? What is the angle between the transverse axis of the foot and the axis of the leg? What is the degree of passive mobility of the foot in all directions? What is the relationship of the anterior and posterior portions of the foot to each other?

Not only the typical equinovarus clubfoot, but also the opposite deformity of calcaneovalgus is important to detect. One of the more subtle deviations that might be difficult to distinguish from the normal if one has not been looking at feet objectively is metatarsus varus, in which the anterior portion of the foot is more or less sharply angulated to the medial side. Early overcorrection of most types of foot deviations can accomplish a great deal before bony structural deformity has taken place.

Congenital Posterior Urethral Valve Obstruction. Obstruction of free urinary flow because of congenital posterior valves in the male urethra results in urinary dribbling rather than the normal forceful

stream of boy babies. If it is not corrected promptly, back pressure causes progressive and irreversible damage to the kidneys. The male newborn infant's chart on the maternity service and in the physician's office or child health conference should have some such item as:

A normal forceful urinary stream has been observed

(check) (date) (initials)

The infant should be left undiapered in the bassinet (or during the medical examination if the physician has quick reflexes) to give opportunity to observe the stream. Once recorded, this need no longer be a matter of concern.

Infancy and the Preschool Years

Later in infancy and during the preschool years, three types of abnormality may be detected by periodic health examination: congenital malformations or birth injuries that were not evident previously, deviations from normal growth and development, and acquired disease conditions.

Orthopedic Conditions. *Torticollis.* Torticollis may or may not have had an antecedent history of a sternocleidomastoid nodule. Since the nodule often does not appear until about 10 days after birth, it cannot be detected at the usual time of examination of the newborn infant, but should be looked and felt for as a routine part of the first weeks of observation. Of course there are other causes for wryneck than sternocleidomastoid shortening. Postural attitudes of the very young infant are difficult to evaluate. Many infants strongly favor keeping the head turned to one side and never have a subsequent deformity. Any consistent tendency to head tilting when the baby learns to sit and stand, however, may look like shyness, but warrants thorough investigation and efforts at correction before permanent asymmetry of the face and realignment of the eyes in relation to the horizontal have occurred.

Dislocation of the Hip. Among conditions present at birth and warranting early treatment, but difficult to recognize at the time of the first examination, is congenital dysplasia or dislocation of one or both hips. True dislocation of the hip is more common after breech deliveries and usually produces immediate limitation in abduction at the joint. With the infant on his back and with his legs fully flexed at the knees, the thighs should be flexed to 90 degrees and then separated. It should be possible to move each limb freely to about 80 degrees from the midline. Occasionally the abduction test will produce an audible or palpable click (the Ortoloni sign) due to the dislocated femoral head slipping over the acetabular rim. Sometimes the inguinal and gluteal

skin folds appear deeper and higher on the side of a unilateral dislocation. Whenever any suspicion exists, roentgenograms of the hips should be taken.

Because of the uncertainty of diagnosis, the hips, especially in girls, should be checked repeatedly during the first months for limitation in abduction[5] and for inequality or asymmetry in position or level. When the child starts to stand, the posterior view may show asymmetry; if the dislocation of the hips is bilateral, there may be an unusual amount of lordosis. Certainly when the child starts to walk, the expressed concerns of the mother about the child's strange gait should not be treated lightly. The gait disturbance may be slight at first and does not have the characteristic "duck waddle" appearance until definite upward dislocation has taken place.

Flatfoot. The feet of the young child are the bane of the average pediatrician's existence. When are flat feet "flat"? As a rule, babies show little or no longitudinal foot arches during the first months of standing and walking, with or without weight bearing, and most continue for a time to throw the feet somewhat into eversion. At 18 months of age, however, complete collapse of the arches on weight bearing can sometimes be demonstrated. These children with so-called true flat feet usually have generalized relaxation of ligamentous structures that can be recognized in other parts of the body as well. Some orthopedists believe that for them, continuous support with arches built into the shoes until about seven years of age will permit development of greater foot strength and reduce permanent foot deformity.

Congenital Scoliosis. Congenital scoliosis, with or without underlying bony defect, can become marked before three or four years of age. Strangely enough, about 90 per cent are reported to be convex to the left. Routine examination of the preschool child should include observation of the line of the spinous processes in the vertical, flexed and prone positions. When the child is lying face down, the line between the shoulders normally should parallel that across the pelvis. Congenital scoliosis is not common, but warrants early and aggressive treatment when it does occur. One essence of good health supervision is to perform a routine and reasonably expeditious examination that will nevertheless detect the uncommon conditions which deserve prompt treatment.

Tuberculosis. Observation of the spine may show a localized splinting and limitation in flexion indicative of an underlying tuberculosis. This can at times be recognized by two, three or four years of age, before the appearance of a prominence or more advanced sign of bony destruction. The first warning of tuberculosis in the hip or knee may be slight pain or limp. Hopefully, in his health supervision work, the physician keeps taking current history on possible exposure to tubercu-

losis, advises all parents to require chest x-rays before employing domestics, and routinely performs a *tuberculin test* at some time in the preschool years. The general reduction in incidence of tuberculosis should not lull us into a false sense of security or prevent us from exercising reasonable precautions. "It happens occasionally in the very best families."

GROWTH OF THE SKULL. In the first weeks careful and repeated measurement of the circumference of the skull is of tremendous importance.

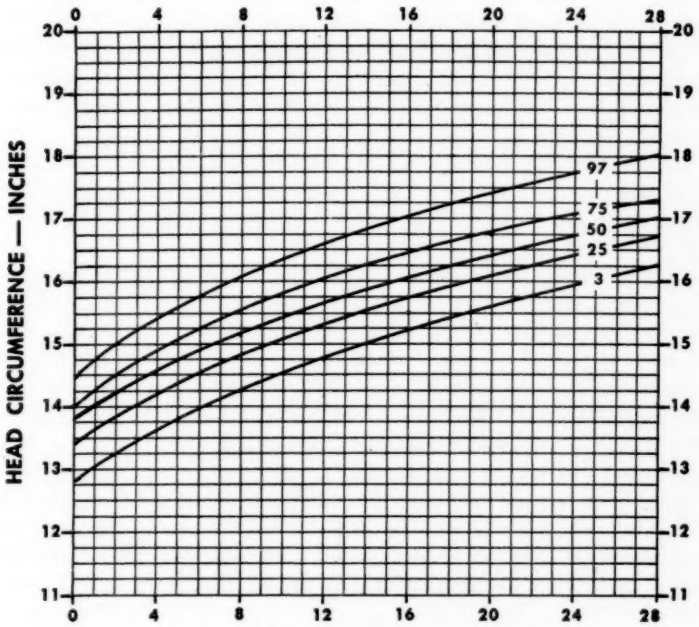

Fig. 5. Example of charting of head circumference.

The technique of measurement should be exact and should aim at obtaining the *largest* fronto-occipital circumference. A steel tape will give more consistent findings. The circumference should be charted (Fig. 5) for prompt demonstration of a trend toward excessive increase or inadequate growth. The latter would give little indication for treatment; the former might call for treatment, especially if associated with clinical symptoms suggestive of hydrocephalus or *subdural hematoma* or cyst. Early treatment before continued pressure has destroyed cortical tissues may make the difference between a normal and a mentally retarded child.

The growth of the skull may be abnormal because of *premature*

synostosis leading to oxycephaly or scaphocephaly. Here the shape of the head is a better indication of possible trouble than is size. When in doubt, a roentgenogram may help decide whether or not operation should be performed to prevent brain damage and visual impairment.

CONGENITAL CRETINISM. Recently a newspaper reported a case of cretinism diagnosed in the first week of life. Of course this is most unusual. Recognition of the condition before two months depends, as always, on keeping the possibility in mind. When an apparently normal baby has obstinate constipation and low food intake that cannot be explained, the level of protein-bound iodine in the serum should be determined and a roentgenogram of the epiphyses for bone age should be taken. When the classical facies and thick tongue have appeared, specific thyroid treatment probably has less effect on ultimate intellectual capacity.

STRABISMUS. One of the most common ways in which health supervision can prevent disability is in respect to the early detection of strabismus. During the second year of life the physician should be on the lookout for signs of incoordination of external ocular movements. Even when the parents report this to the physician, there may be no obvious imbalance in the movements of the eyes at the time of the examination. But the parents often describe how one eye tends to turn whenever the child is tired. In some instances the deviation has been detected on a photograph before it had otherwise been noticed. Any stories such as these are sufficient indications for further testing. Questions on eye incoordination should be part of the history-taking around the second birthday. Regardless of the answers given, the physician should do a routine eye check around the second, third and fourth birthdays to make sure that there is no tendency to incoordination outward or inward (exophoria or esophoria), as contrasted with a definite deviation (exotropia or esotropia). He can do this by the simple *cover test*, which can be made into the form of a game with the two-year-old, especially if the mother is involved in the procedure. Cover one eye with a card, hold the child's attention fixed on a distant object, quickly remove the card or shift it to the other eye and see whether the first eye jumps into alignment. Another test is to determine the locations on the cornea of a reflected light, as shown in Figure 6. Whichever test is chosen, the physician must familiarize himself with it by constant routine use on many children before it can become a reliable tool in his hands.

Failure to detect a strabismus that is present or to refer immediately for specialized care is most unfortunate. If treatment of a strabismus is too long delayed (almost any time is too long), binocular vision or fusion of the two images may never develop. In addition to having lost

the capacity for good depth perception by binocular vision, the strongest factor for maintaining coordinated eye movements is lost. It then becomes difficult to retain a good cosmetic result even with surgery. Furthermore, if constant uniocular vision results, visual acuity in the unused eye deteriorates (amblyopia ex anopsia).

HEARING. The hearing of young children should be tested routinely about once a year, starting at as early an age as possible. Richmond and his associates[6] have suggested practical ways of testing newborn infants by observing their startle reaction to a percussion "cowbell." Each physician can develop his own variation of an office technique for obtaining a "candid" response to an unexpected sound. These are probably preferable to a whisper or watch tick test for rough screening

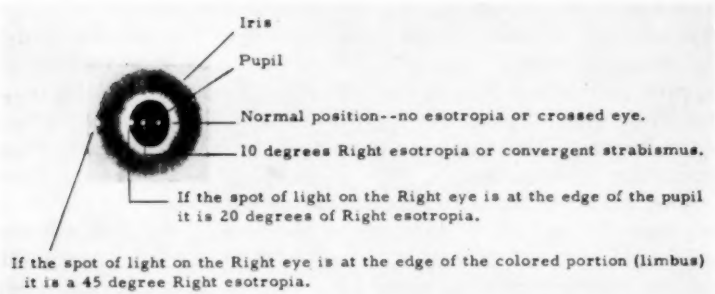
Iris
Pupil
Normal position--no esotropia or crossed eye.
10 degrees Right esotropia or convergent strabismus.
If the spot of light on the Right eye is at the edge of the pupil it is 20 degrees of Right esotropia.
If the spot of light on the Right eye is at the edge of the colored portion (limbus) it is a 45 degree Right esotropia.

Fig. 6. Composite diagrammatic view of the reflections of light from the cornea of the right eye to demonstrate concisely the possible positions of reflections. (Adapted from G. P. Guibor: *Journal of Pediatrics*, Vol. 47.)

of gross impairment, but have value only if the physician uses the method often and with reasonable uniformity. Infantile speech patterns and behavior disturbances may be clues to possible hearing defect, but are not reliable. One story that can sometimes be elicited is that the child has difficulty identifying the direction from which sounds come, so that he may go into the wrong room when called by his mother. When in doubt, a properly performed audiometric test gives the definitive answer. Early evidence of residual hearing loss in a child who has had a number of middle ear infections constitutes urgent indication for prevention of progressive hearing impairment by aggressive treatment of respiratory infections. Knowing that some hearing impairment has already occurred may motivate the parents to cooperate with a prophylactic antibiotic regimen if such should be recommended.

CARDIOVASCULAR SYSTEM. Some time during the first year of life the physician should satisfy himself by palpation that there is a good fe-

moral pulsation in both lower extremities and, therefore, little chance of *coarctation of the aorta*. Once he does so, he should record this in a designated place on his record forms and need not thereafter have to include femoral palpation in physical examinations of this child.

During the first year and the several years that follow, the physician should keep careful tab on the heart sounds to make sure that he has not missed a *congenital heart* condition. A murmur can develop even though not present at the outset. Such a change often occurs with a patent ductus arteriosus as the increasing mass of the child's growing body produces progressive alteration in pressure balance between the two sides of the heart. The sequence of findings would move from absence of a murmur to a systolic murmur and finally to the typical continuous "machinery" murmur. With many types of acyanotic congenital heart disease, growth may not be noticeably retarded or nutrition impaired, and only careful auscultation may give the clue to the desirability of surgical correction. When other symptoms or findings do exist, such as easy fatigue, frequent assumption of a squatting position in the preschool years, or a growth curve in the lowest percentiles out of keeping with the expected pattern in the family, x-ray and other studies may be warranted.

Here, again, the value of graphic charting is evident. The physician can obtain an immediate impression of the status of the child's height and weight, not only in terms of the percentile place in his age group, but also in respect to his deviation from his own previously established norm. Figure 7 shows the roughly parallel bands or zones of growth within which each child is more or less expected to remain during good health. Almost no other routine record can equal in value the graphic height-weight chart kept continuously in the physician's office.

This may be a good place to emphasize that a diagnostic roentgenogram is advised only when some specific indication for it exists. Medical radiation is cumulative over the years and should not be advised too freely. Certainly, "routine fluoroscopy" should be considered a misnomer and is not an appropriate part of health supervision.

URINALYSIS. At reasonable intervals the health supervision of a child should include a routine urinalysis even though the positive findings will be meager. One might ask for one about the first birthday and perhaps every two years thereafter. A routine urinalysis that uncovered an otherwise unsuspected *juvenile diabetes* would help that child to be placed on a controlled regimen at an early age. It is quite likely that maintaining diabetic control and minimizing the number of escapes from control will slow down acceleration of severity of the disease process with the years. A routine urinalysis in the preschool age may on occasion show albumin or pus cells due to an unsuspected *congenital malformation of the genitourinary tract*. In such instances early opera-

tion may be the saving factor in preventing irreversible destruction of still functioning renal cortex.

At present, consideration is being given to the advisability of performing a routine test on the urine of all babies to detect excessive amounts of phenylpyruvic acid in cases of an inborn disturbance of protein metabolism. The abnormal products of protein breakdown which are toxic to brain cells and produce the type of mental retardation

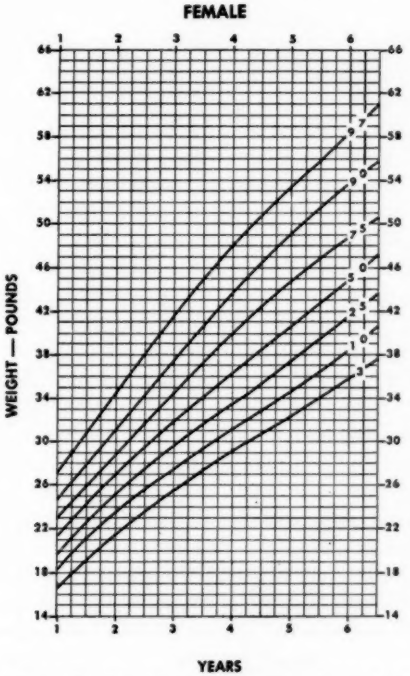

Fig. 7. Example of weight chart for girls of preschool age.

known as phenylpyruvic oligophrenia turn green when ferric chloride is added to the urine. Difficulty of obtaining specimens from young infants and determination of the time after birth when the test becomes positive are factors in deciding on the exact technique that would be recommended. If present indications are confirmed that a diet low in phenylalanine may minimize or prevent brain damage in children with this metabolic disturbance, it may become worth while to try to differentiate the one child in 40,000 who is affected.

VITAMINS. One of the functions of health supervision is to advise the parents on the feeding of the child. This will help to maintain his nutri-

tion at an optimum level and will prevent conditions such as rickets that can result in body deformities when severe. Fortunately, severe rickets has become extremely rare in the United States. As a matter of fact, pediatric hospitals are probably now admitting more children with symptoms of *hypervitaminosis* than vitamin deficit, especially since the oil soluble vitamins A and D have been given in concentrated form. The early signs of hypervitaminosis A and D are insidious and include loss of appetite, which in turn often results in an effort to increase the dose of vitamins. The physician giving health supervision should keep an eye on the actual amount of vitamin concentrate given, by knowing the preparations by name and content, by asking the mother exactly what level she uses in the dropper and by being aware of the amounts of vitamins present in fortified milk and other foods sold in the community. With the present general practice of early addition of solid foods to the infant's diet and with widespread fortification of foodstuffs, it is easy to attain a high vitamin intake. Permanent handicaps that might result from early, severe and prolonged hypervitaminosis are renal defect and mental retardation from D and A respectively.

On the other hand, the current infrequency of gross hypovitaminosis has lulled us into a lessened state of alertness on vitamin intake. Paradoxically, infants on elimination diets prescribed by pediatricians for diagnosis and treatment of allergies have acquired *hypovitaminosis* A. Xerophthalmia can lead and has led to blindness. In other cases, interference with absorption or utilization of fat-soluble vitamins has produced symptoms whose significance was not recognized promptly because the quantitative oral intake of vitamins was adequate.

Mental Health. In health supervision the physician has opportunity to observe the kinds of relationship that exist within the family, particularly between the mother and the child. These relationships are based upon deeply rooted factors over which the physician himself may have little influence. His recognition of the type of relationship, however, helps him to be more effective in the counseling that he is able to give and to present his recommendations in a light that is more likely to be accepted. David Levy[3, 4] has given excellent suggestions on ways to objectify the physician's appraisal of the mother-child relationship so that his conclusions are not ones that he arrives at as a layman, but have some degree of scientific underpinning.

The mother's behavior when the child receives his injections and during other phases of the office visit offers occasion for assessment by the physician. The most important first step is merely his being aware that the way the mother and child get along together and feel toward each other is one of the items included in his health appraisal of the child.

Parents in the past 15 or 20 years have been confused by the rapid shifts in philosophy and teaching on the part of pediatricians and other professional persons concerned with child rearing. It behooves us at the present time to give our guidance and counseling to parents in some other way than as "the very latest dictum" which we may regret five or 10 years hence, at the time of the next shift in point of view. We hope we are doing this by not claiming to have pat answers to mothers' questions or the "only correct" solutions to their problems. Instead, we aim to give parents a foundation in understanding of their children so that they can gain confidence in the decisions which they themselves reach. This foundation is a philosphy about children that has several components:

1. The child is a person who has rights and privileges and a sense of dignity. He should not be humiliated, and his rights should be respected. He should be involved in the running of his life and be given a chance to think and to express himself.

2. No two children are alike. Within the normal range of children, each child has his own particular norm to which he will tend to adhere. Rather than his being compared with an average or with a sibling, neighbor or cousin, he should be observed for indications of possible abnormality in terms of departures from his own norm. The parent should try to accept the child as he is, within his own potentialities, instead of trying to fit him into a preconceived mold.

3. The degree of emotional maturity of a child at any time does not go hand in hand with mental capacity, language development or physical size.

4. A child needs to be understood at the age level in growth and maturation that he has attained. Timing is the essential factor; what is right at one time is not necessarily right at another. The parent is helped to understand how not to push a child too fast or wait too long for him to assume responsibilities and show accomplishments.

5. The relationship in the home should be a democratic one. This means neither excessive parental authoritarianism on the one hand nor, on the other, permitting a child to run wild in an anarchic environment. The child needs laws and limits. We believe that reasonable limits and reasonable punishment constitute the most effective and constructive discipline.

6. Parents are human. They too have rights and privileges as well as emotions. They need not feel guilty about being less than perfect, even getting angry at their children and at times disliking them.

Getting these concepts across to the mother is more important than having a pat answer to her question, "What should I do when my child has a temper tantrum?"

The Child of School Age

In the school-age child many of the same items in health supervision come to the fore for prevention of handicapping conditions. Accident prevention cannot be stressed too much. Vision and hearing require periodic testing. For the heart, the outstanding concern is *rheumatic fever*, its early recognition and its prevention by adequate treatment of certain respiratory infections and by maintenance prophylaxis when necessary. For bones, the chief problems are *scoliosis* and the epiphysial and *focal aseptic necrosis* group of diseases, such as Legg-Perthes in the hip, Osgood-Schlatter's in the tibia, and others. The physician should routinely make careful observation of the spine in the prone, erect and flexed positions so that incipient scoliosis can be recognized and referral made for specialized observation and decision on the need and timing of treatment. Full attention should be given to complaints of hip or knee pain. Localized swelling and tenderness in the foot of a boy five or six years of age would suggest involvement of the tarsal navicular bone (Koehler's disease). Unilateral bowing of the leg about seven years of age would call to mind aseptic necrosis of the medial tibial condyle (Blount's disease). Such conditions occur especially in boys, probably because of their physical activity.

The physician who examines a child must not forget that the *teeth* are part of the body. He should look for gross caries, evidences of hypoplasia, deformity or malocclusion. When deciduous teeth have been lost early, he should refer the child to a dentist for consideration of space maintainers. When there is malocclusion, he should refer the child to a dentist for *orthodontic care* long before adolescence.

During the school years, and particularly adolescence, the child is in need of direct *counseling and guidance*. The physician often is in a unique position to give or cooperate with such help for the child. Space does not permit elaboration on this extremely important aspect of health supervision.

From birth to adulthood, health supervision should be given in such a fashion that it involves the parent and also the child himself. He should be a party to his own health maintenance so that he learns that he has a responsibility as well as a contribution to make and so that he gains the habit of thinking of preventing disease and disability rather than waiting for them to develop.

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PREVENTION AND TREATMENT OF VISUAL DEFECTS IN CHILDREN

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Despite the severe limitations on prevention of some visual defects, nothing could be more gratifying than working with babies and children in the prevention of other visual defects and in the treatment of their eyes to avoid visual loss.

The limitations of prevention are largely in the field of genetics. Here many defects *could* be prevented by proper selection of marriage partners or by control of reproduction. In actual practice we know that eugenics remains only a desirable possibility for the future.

Much can be done in an educational way to prevent accidents, to promote proper examination of the eyes at regular intervals, acceptance of public health measures and proper prenatal care of women, and to encourage prompt treatment of ocular infections, injuries and muscle deviations.

Of all these things, routine examination of the eyes offers the most promise. By this means we can detect many possible causes of visual loss while there is yet time to do something about them. Education of the public is easy when people come for routine examination, for at such times they observe other patients with eye troubles, and they are prompted to ask questions about diseases of the eyes. Certainly every parent learns something whenever he takes his child to an ophthalmologist. It is obvious that parents whose children are cared for by pediatricians know more about children's diseases than those who just let their children grow up, seeking medical attention only when it is acutely needed.

ROUTINE EXAMINATION OF CHILDREN'S EYES

Consideration of prevention and treatment of visual defects implies adequate examination of the eyes. If a statistical report of adequate and

timely examinations were available, we would all be shocked by the small percentage of eyes examined, almost to the point of doing something about it!

With all due respect to feasibility, practicality, the time element, the shortage of doctors and the odds against something being wrong, one must still say that we are all remiss in not doing our best to ensure proper examinations at the proper times in the lives of babies and children. Most pediatricians do not check the eyes of newborn babies in the hospital very carefully, nor do they ask for ophthalmologic consultation on a routine basis even when it is easily available. The same is true of general practitioners. The ophthalmologist has not done enough missionary work to show the advisability of examination of all eyes. Parents neglect this, too, but are less to be blamed, for they depend on their doctors to advise them.

At what times should children's eyes be examined, and what should be looked for?

The first examination should be made in the first week of life. It may be necessary to do this a second time, since the lids are not well opened and there may be some chemical conjunctivitis from the silver nitrate instilled after delivery.

The minimal examination includes examination for gross deformities of the skull, facial bones, and eyelids. Opening the lids may require lid retractors, which should be available in the nursery of every hospital. The corneas should be examined for clarity and luster. The pupillary reactions to light should be tested. With the ophthalmoscope one should check the fundus reflex, which will disclose any opacity of the lens. Ideally, the fundi should be examined after dilation of the pupils (using Eucadryl or Mydriatin, one drop in each eye at five minute intervals for three doses). This examination is difficult and not always reliable unless one is accustomed to examining the interior of the eye of the newborn. Lid retractors are a "must." Certainly examination of the fundi should be done if any defect is found on external examination or if oxygen is being given to a premature infant. If the cornea is steamy or clouded or oversized, an ophthalmologist should be called in promptly to check the pressure and to rule out glaucoma.

The next examination should be done at age six weeks; the next at age six months. If any abnormality is found, an ophthalmologist should be called in consultation.

If the eyes do not appear to be straight at age six months, the child should be referred to an ophthalmologist to be followed up. At latest, referral of children with muscle imbalance should be made at 12 months of age. The ophthalmologist can almost always be certain of orthophoria or strabismus by this time. Early treatment gives better results with much less effort on the part of the mother. Prevention of ambly-

opia ex anopsia alone is worth while at this age and is much more effective early than late.

The *screen* or *cover test* should be done while the child is looking at a small light. Any "jump" of the just-uncovered eye inward or outward to fix on the light indicates some muscle imbalance. This test is far superior to judging the alignment of the eyes by the amount of sclera visible between the iris and the inner canthus or by the position of the light reflexes on the cornea.

The nearpoint of convergence should always be tested. It should be within 10 cm. of the base of the nose. It is best tested by using a small light which is not too bright. This is brought *slowly* toward the child's nose; usually he will follow it. Almost every child will smile if the examiner touches the end of the child's nose with the light. The test can then be repeated with more accuracy.

The ocular rotations should be checked with both eyes open, and with each eye covered if there is any failure of the two eyes to move equally well in any direction of gaze. It is useful to say, "Follow the light—don't let it get away."

One should take time to acquaint the child with the light, so that he will not be afraid. If he touches it, he is usually convinced that it will be all right. Then it should be moved *slowly*, especially toward the face, to avoid frightening the child.

The cover test should be done slowly to avoid confusing the child and to permit him to fix the light with each eye. The examiner will also do better with slow covering of each eye from right to left, and vice versa, since the movement to fix will be more certain. The greater the "jump" or movement of redress in or out, the greater is the deviation to be measured.

During these examinations the parent and office nurse should remain in one spot and should not talk. Children are easily distracted by sound and by movement. Once attention is lost, it may not be regained during that session.

Examination of the fundi should be done *with the pupils dilated* and in a darkened room under favorable circumstances at age one year.

All children should be completely examined at age three and a half to four regardless of how normal the eyes appear and despite absence of complaints. This examination should include testing with and without cycloplegia (atropine or Cyclogyl). Retinoscopy will determine the refractive error on a completely objective basis as long as the internal muscles are relaxed with a cycloplegic. By age three and a half to four one can elicit visual acuity by having the child indicate the direction of the "fingers" on an **E**-chart by holding his outstretched fingers in the same direction.

For example, an E which is pointed upward looks like this— E,

so that the child points his fingers upward. The next E might face to the right (E), and the child will turn his hand sidewise, with fingers stretched out to the right, and so on.

For the most part a child will do this (1) if he can see, and (2) if he understands "how the game is played"—or what is expected of him. If he does well with one eye, and becomes unruly, cross or tearful while the other eye is being tested, he probably *does not see* the chart with the second eye. Prolonged insistence that a child read a test-card is inadvisable, as well as a waste of time. A second session on another day will be more worth while, especially if the mother has taught him in the security of his own home how to point to E's on a paper before he returns.

Examination of the interior of the eye, measuring the intraocular pressure with a tonometer, probing the tear sac, or forcibly rotating the eyeball by grasping a muscle with forceps requires general anesthesia for children.

STRABISMUS AND AMBLYOPIA EX ANOPSIA

The most preventable visual defect is that of poor vision from disuse of an eye. This occurs in two situations: first, in an eye which is not used because it is not properly aligned with the fellow-eye (strabismus), and, second, in an eye whose refractive error differs greatly from that of the fellow-eye (anisometropia). In both situations the child uses only one eye, and the fellow-eye fails to get the usual and necessary exercise. Visual acuity is poor at birth and develops only with use of the eye.

In all strabismus cases, except for the purely alternating type, one eye is used for fixation, while the image seen with the other eye is suppressed in order to avoid double vision. If suppression is continued for a long time, visual acuity does not improve. Occluding the better eye to force the use of the deviating eye is necessary, whether or not glasses are used. Occlusion must be complete and constant. Patching for a few hours a day, "while watching T.V.," is of little value. Stress should be made on the use of occlusion as early as possible in the child's life, since the rapidity of improvement is much greater in the very young. It is generally agreed that visual acuity cannot be improved after age six; though not strictly true, it is almost so. Response to patching at age two is infinitely better and more rapid than is the response at age four. If one is in doubt as to which eye deviates more, alternate occlusion is easily carried out and guarantees equal development of visual acuity in the two eyes. An Elastoplast patch is available and excellent except in hot weather. "Mystik Tape" on one lens is cooler, but allows "peeking."

Operation for strabismus does not improve visual acuity, and, unless

it permits binocular single vision, does not even ensure use of the eye. One must, therefore, continue observation and visual training as necessary after even the most successful cosmetic result has been achieved.

When the refractive error of the two eyes is quite different, glasses should be prescribed. If visual acuity is unequal, patching the better eye plus constant use of the correcting lens is essential. The most troublesome situations are those in which the hyperopia or myopia is much greater in one eye than in the other. Here the child finds one eye so much easier to use than the other, or he is able to use only one eye for distance vision, that he unavoidably fails to improve visual acuity in one eye unless proper lenses and occlusion are provided.

REFRACTIVE ERRORS AND THE NEED FOR GLASSES

In discussing amblyopia ex anopsia it was pointed out that markedly unequal refractive errors often lead a child to use one eye alone, unconsciously. Wearing correcting lenses and occlusion of the eye with better vision were recommended to bring up vision in the poorer eye.

What, then, about glasses for other reasons? What about nearsighted, farsighted and astigmatic eyes?

Myopia

Nearsighted, or myopic, people cannot see well in the distance, but their vision for near is usually very good, even though the book may have to be held close. They often see better, i.e., more easily, for near without correcting lenses than with the glasses on. However, they can also see well for near with glasses on. If vision is 20/40 or less, glasses should be available to ensure reading the blackboard at school or for appreciation of distant objects. Certainly if vision is 20/100 or less, the child will want to wear glasses almost all the time. He may be an excellent student because his myopia lets him see books without effort and he is not distracted by things he does not see in the distance. Since he is unaware of his defect, he does not complain and may even go near the blackboard after class to see what he missed during class. A parent can compare his distance vision with his children's, using traffic signs, license plates, birds flying and so forth as tests, or take him to read a Snellen chart now and then.

When glasses are prescribed for myopic children, parents and teachers should not insist on their constant wear. Rather the child should be told, "Here are glasses which will make you see better in the distance; wear them as much as you want to." Left to their own choice, most children will elect to wear glasses except when at play. Shatterproof lenses reduce the number of lacerations of the eyeball by broken lenses.

If myopic astigmatism is at all marked, constant use of glasses is preferable, but tactful presentation rather than forced use is advisable.

Hyperopia

This term is preferable to "farsightedness,"—which implies good distance vision. A hyperopic person may see very well for distance and less well for near, or may see poorly for both distance and near. So we see how poor the term is. Hyperopia means that the eyeball has an anterior-posterior diameter shorter than normal. In order to get rays of light to focus on the retina, the ciliary muscle must contract to render the crystalline lens in the eye a better condensing instrument (accommodation). This means that more accommodation must be exercised constantly, even for distance vision, and an increasing amount is needed for near work. Therefore, fatigue will be a factor, and disinterest in close use of the eyes is likely.

Testing for hyperopia requires good cycloplegia, or the "use of drops." If one eye is more hyperopic than the other, the child will use the eye with less hyperopia. This means that the fellow-eye will not be in focus at the same distance, and so disuse occurs. Correction with plus lenses makes the use of the eyes much easier. Very hyperopic children will welcome glasses and will put them on each morning without being told to do so. When hyperopia is equal and not marked (under + 3.00 diopters), correcting lenses are not necessary. Hyperopia of + 4.00 diopters or more is often associated with convergent strabismus (esotropia).

Accommodative convergent strabismus is diagnosed when the eyes are straight with correcting lenses on and one eye deviates in with the glasses off. Prevention of amblyopia ex anopsia is important here, using lenses alone or, if necessary, combined with occlusion of one eye.

Astigmatism

This may be hyperopic, myopic or mixed. If it is not over 1.5 diopters in amount, correcting lenses are not needed until the child is older. More marked astigmatism, especially of the hyperopic variety, warrants correcting glasses.

Astigmatism of 2.5 diopters or more demands constant wearing of glasses as early as it is detected. Correction of myopic astigmatism is less essential because the child sees reasonably well for near even without glasses, whereas farsighted astigmatism prevents a clear image at any distance from the eye.

Oddly enough, mixed astigmatism allows good vision and causes few symptoms until age 20 or 30.

Summary

To sum up the use of glasses to prevent visual defects, one can say:

1. A sharp image on the retina early in life is necessary for full development of visual acuity.

2. Using plus lenses reduces the overconvergence which goes with excessive accommodative effort (third nerve supply for both) and so helps some types of convergent strabismus.

Contrariwise, minus lenses for myopia help the patient converge, so overcoming the divergent strabismus which is often associated with myopia.

3. Correction of unequal refractive errors in the two eyes allows them to be used together, affording binocular single vision and so also avoiding amblyopia ex anopsia.

All children should be tested for refractive errors by an ophthalmologist. Optometrists have no place in testing children because they lack medical training, because they cannot use cycloplegic "drops," and because they do not and cannot do adequate examination of the eyes at the same time that the refraction of the eye is determined.

ACCIDENTS

The prevention of accidental injuries to the eyes is a difficult matter. Banning of B.B. guns and fireworks by law has proved effective in those communities in which such ordinances have been passed.

It is impossible to prevent accidents by legislation alone, however. A constant educational campaign in newspapers, magazines, and by word-of-mouth advice to parents from pediatricians and general practitioners is the best method of prevention. They must be warned about arrows, sharp sticks, slingshots, knives, scissors, glass bottles, easily breakable toys, and about the danger of foreign bodies from pounding metal on other hard objects.

In the treatment of injuries, promptness is important. Both perforating and contused injuries respond better early than late. Suturing of even small lacerations saves many eyes each year. Prevention and treatment of infection in injuries are most important. No injury is too slight to warrant careful examination as soon as possible. The over-all cost of prompt treatment of all eye injuries by an ophthalmologist would be less than the present cost of delayed care of just the more serious injuries. The fault here lies not with the pediatrician or general practitioner, or availability of ophthalmologists, but with parents who, because of lack of knowledge, "wait to see how it will be tomorrow." Parents must be taught preventive methods before they can teach their children. School officials and teachers also need information on prevention of accidents.

There seems to be no substitute for good judgment or for constant supervision of children at play during those years in which they cannot think for themselves. Grandmothers have a definite value in supervisory capacities; certainly they outrank teen-age baby-sitters in the prevention of injuries.

VENEREAL DISEASE

One of the most outstanding records of prevention of visual defects has resulted from the mandatory use of silver nitrate in the eyes of newborn babies. Before the introduction of silver nitrate, gonorrheal infection was a common cause of loss of vision. When properly carried out, the Credé method has reduced the incidence to almost zero. In the presulfonamide days treatment of gonorrheal infection of the eye was most unsatisfactory, even when 24 hour special nursing care was available for afflicted infants. Now there are many drugs which will eradicate the infection promptly. Considerable effort has been made to substitute antibiotics for silver nitrate as a routine in prevention. Because the chemical conjunctivitis following silver nitrate instillation is not serious, and because of the possibility of inducing sensitivity to antibiotics, especially penicillin, there seems no need to change existing laws or methods. If any change were to be made, one of the sulfonamides would be preferable, since inclusion-body conjunctivitis can be prevented at the same time. This virus disease comes from a cervical infection in the mother and begins in the eye on the seventh to the tenth neonatal day; it tends to be persistent.

Congenital syphilitic infection has been largely prevented by routine prenatal serologic testing which leads to proper treatment of the mother at the time when her own response to chemotherapy and penicillin is at its best. Treatment of congenital syphilis by drugs and fever therapy has been tremendously improved, so that visual damage from keratitis and choroiditis is infinitely less than it formerly was.

Because of wide use and acceptance of serologic tests, acquired syphilis is also diagnosed much earlier than it used to be, and one seldom sees active uveitis or optic atrophy due to syphilis.

One cannot write anything on this subject without repeating the warning of health officers that both gonorrhea and syphilis are *again on the increase*. Hence if we wish to keep up the splendid record of the recent past, constant vigilance will be still necessary.

ENDOGENOUS INFECTIONS

Certain systemic diseases in children may be responsible for metastatic retinitis or endophthalmitis. Meningococcal meningitis, the ex-

anthematous diseases, pneumococcal pneumonia, and so on, may be complicated by ocular involvement. These are less frequent because of the response of some of the diseases to chemotherapy and antibiotics.

Toxoplasmosis is transmitted from the infected mother to the unborn baby. The lesions tend to be bilateral and usually involve the macular areas, so that visual damage is severe. Treatment of the mother is most important. The child's eyes are involved in irreversible manner. The next few years should see great progress in the prevention of this and similar diseases—histoplasmosis, coccidiomycosis, and the like.

Brucellosis is not a common cause of ocular inflammations in children, but is preventable if all public health regulations are followed.

The importance of *nematode infestation* as a cause of chorioretinitis has been brought out in the past 10 years. Here again prevention is possible by following well established public health measures. Specific treatment of active eye lesion is almost unknown. Indeed, the diagnosis is seldom made except on histopathologic examination.

Rubella, or German measles, involving the mother during the first trimester of pregnancy can result in severe damage to the eyes and other organs of the fetus. Cataract, microphthalmos, secondary glaucoma, atrophy of the iris, strabismus, and degeneration of the retina have been reported. Deaf-mutism, cardiac involvement and mental deficiency also occur. There is some evidence that gamma globulin in doses of 0.2 cc. per pound of body weight may be protective if given to the mother within one week after exposure to rubella. Obviously the best method is to prevent the occurrence of rubella by exposure of all girls before they reach the childbearing age.

Immunization against influenza, smallpox, chickenpox, measles, mumps, diphtheria and scarlet fever is also advisable, although not all children born of mothers who had been infected by these during pregnancy show ocular defects.

Avitaminosis in the pregnant woman may result in ocular defects in the newborn just as infections, inflammations and traumata may affect the developing eye. The stage at which these noxious agents are active determines the part of the eye to be involved, and such arrests in development may simulate sporadic genetic phenomena.

DACRYOCYSTITIS

Occasionally a child is born with one or both tear ducts blocked. Tearing is not marked. The mucous secretion and epithelial debris collect in the tear sac, which usually becomes secondarily infected.

No medication is effective, and so none should be ordered.

Occasionally the membrane can be ruptured by forcing the contents

of the dilated tear sac into the nose by digital massage. Irrigation of the nasolacrimal duct may be effective.

Usually, however, it is necessary to pass a silver probe through the canaliculus and nasolacrimal duct to rupture the membrane. This may be followed by irrigation if necessary, but reprobing is rarely necessary. This can be carried out at any age and should not be delayed beyond six months of age. When feasible, it can be done in the office without general anesthesia.

The results are excellent.

RETROLENTAL FIBROPLASIA, OR RETINOPATHY OF PREMATURITY

During the past 15 years one of the most notable phenomena in all medical history has been observed. That is, a completely new disease of the eye has been described, studied extensively, and eradicated by cooperative clinical and laboratory research. In 1942 retrolental fibroplasia in premature infants was first described. By 1948 the true nature and clinical course of the disease were properly understood. By 1951 the relation of intensive oxygen therapy to the occurrence of the disease was reported. By 1955 the pathogenesis had been proved clinically and in laboratory animals.

In brief, too much oxygen affects the incompletely developed retinal vessels, causing vasoconstriction, which suppresses vascularization. Secondary proliferation of endothelial cells leads to new vessel formation on the retina and in the vitreous. Detachment of the retina may follow. Regression may occur at any stage.

Prevention of the disease by giving the least amount of oxygen necessary for survival of the premature infant has been a spectacular success.

All premature infants should be examined carefully by an ophthalmologist. Severe myopia in one or both eyes is now being found in those children who had retrolental fibroplasia in one eye, and in those premature babies who just escaped clinical evidence of the disease.

CONGENITAL CATARACTS

Early recognition of congenital cataracts allows proper evaluation of the visual status of a young child. A monocular congenital cataract is usually left alone. Small opacities in the embryonic and fetal nuclei may likewise not require operation, but large cataracts may reduce vision sufficiently to require operation at age six months. Zonular opacities are usually observed at intervals, and operation is postponed until the child is older. The important thing is that enough rays of light can be focused on the macula to permit development of central visual acuity. As long as this is possible, operation can be delayed to get the better coopera-

tion of the child and the greater safety of general anesthesia. If the child obviously does not see, if nystagmoid movements develop, or if the fundus reflex is absent and no view of the fundus can be had, the operation should be done so that the eye will be used as early as possible in the child's life. The results from operation are good, but separation of the retina is not uncommon about 20 years later.

GENETIC FACTORS IN OPHTHALMIC DISORDERS

A study of the causes of blindness in England in 1948–50 showed that 50 per cent of those in the 15 to 30 year age group and 25 per cent of those in the 30 to 50 year age groups were blind because of congenital hereditary factors. The incidence of these has been rising in the past 20 years.

These disorders range from obvious developmental defects such as colobomas and mandibulofacial dysostosis through the phakomatoses which become manifest later in childhood, to those hereditary traits which have a late onset, such as some cataracts, some glaucomas, macular degeneration and diabetic affections of the eye.

Some conditions are dominant, such as migraine and angioneurotic edema. Others are dominant with variable expressions, such as the phakomatoses, arachnodactyly and brachydactyly with spherophakia, and the syndrome of blue scleras, fragile bones and otosclerosis. In the latter all have blue scleras, 60 per cent have fragile bones, and only 24 per cent have otosclerosis.

Some are irregularly dominant such as mandibulofacial dysostosis, with which deafness is a common and important-to-recognize coexisting defect. Some are sex-linked dominant traits such as retinitis pigmentosa. Others are recessive, and here consanguinity is most marked. The Laurence-Moon-Biedl syndrome is an example. Incomplete dominant and recessive inheritance also occurs. Interesting are those in which a disease has an anticipatory element such as diabetes. In one local family the grandson was first found to have diabetes, later his father, and several years later still, his grandfather was so diagnosed. Some diabetes has dominant and some recessive modes of inheritance.

What can be said of prevention of genetic defects? First, we do not know enough about the subject. Second, what is known is not widely appreciated. Third, it would be difficult to stop people from joining genes with a eugenically undesirable marriage partner even though the probable outcome of such a union were clearly explained to both parties.

In actual practice most of us do not know much of our own family traits or inheritances. Even if one knows that several members of the family have diabetes, cataract, colobomas, and so on, he is not likely to

inquire into the family tree of the person to whom he plans to be married. If he did so, he might have difficulty getting competent advice.

The prospect of prevention of genetic defects seems poor for the future, as is usually the case with things requiring education of both the professions and the lay public. In a world in which marriageable people wonder whether they will survive the next atomic explosion, it is asking a great deal for them to consider the disadvantages of continuing a line of people with blue scleras, neurofibromas, drüsen of the nervehead or migraine headaches. If a person has survived retinoblastoma (a 50 per cent chance of survival in past years), he probably would take a dim view of foregoing fatherhood, let alone considering a life of celibacy if his religious inheritance forebade birth control.

Nevertheless, doctors do have a responsibility in advising people about eugenics. Pediatricians are in a particularly advantageous position for discovering congenital defects and hereditary traits.

RETINOBLASTOMA

This is a congenital tumor arising in the retina. It is bilateral in about one third of the cases. Uniformly fatal unless treated, this tumor has had a 50 per cent mortality rate in past years. About 100 children per year are affected in the United States.

The safest treatment is enucleation of the eyeball. In the past few years unusually good success has been obtained by combined treatment with x-ray and T.E.M. (triethylmelamine) given intravenously. This is usually given to the second eye after enucleation of the more involved eye.

Retinoblastoma occurs sporadically, but has been recorded in several generations of a family. Siblings of a child with retinoblastoma have the same chance as the general population of children to have such a tumor. However, almost all children of survivors of retinoblastoma are likely to have bilateral retinoblastomas. Therefore survivors should be urged not to have children.

OPTIC ATROPHY

Papilledema and optic atrophy in hydrocephalus and craniostenosis and brain tumors can be prevented or relieved by early recognition and operative relief of the increased intracranial pressure.

CONGENITAL GLAUCOMA

This may be due to an anomalous development of the filtration angle or to some intrauterine disturbance. Though the operative treatment is

much more often successful than it was in former years, the results still leave something to be desired.

Early recognition and treatment are necessary to prevent loss of visual fields and later of central vision.

READING PROBLEMS

Perhaps reading problems need not be considered under visual defects, but inability to use effectively a normal organ of the body is equivalent to a real defect. Poor reading is a great handicap in the modern world.

Most reading disabilities are *not* due to the eyes. However, careful examination of the eyes *and of hearing* are necessary before looking for other causes. If these are normal, one should check for mirror-reading, for crossed dominance (using right eye and left hand, or vice versa) and for poor attention to the task of reading. The intelligence quotient should also be determined.

Then one looks into the manner in which reading was first taught. The "old-fashioned" method of teaching, including phonetics, is the best. Some use of flash cards to promote recognition of whole words at a glance and later on teaching a child how to scan a paragraph add to the speed and pleasure in reading. One should listen to a child read aloud and insist that he be looking several words beyond the one he is actually speaking. Not all children will learn to read equally well or equally rapidly, of course. Some will learn by one method better than they would by another method. Hence a different approach may be all that is needed.

Emotional problems, especially in the home, are often most important in reading problems.

Remedial reading carried out by well trained instructors is the best method of retraining a child. This should be done early, before a psychological "block" occurs. A *child will not try if he has been convinced he cannot read well.* He does not want to display his lack of ability. Furthermore, he needs encouragement, not only that he can soon do better, but also that his other school work will be more fun and easier when he has practiced reading more. Meanwhile, he should be adequately praised for other things he does well, especially for any progress, however slight, he is making in reading.

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HEARING DEFECTS IN CHILDREN

JOSEPH SATALOFF, M.D.

When a mother brings a child to the physician and complains that Johnny is four years old and still cannot speak, or that Susan seems backward in school, disinterested and inattentive, the first question that should arise in the mind of the physician is, "Can this child hear?" One of the earliest clues to the presence of a hearing loss is retarded or defective speech. Temper tantrums in a speechless child, retarded school work, inattention and many emotional disturbances may be caused by varying degrees of hearing impairment. The early detection of a hearing loss by the pediatrician can generally prevent serious future disability.

Such detection, however, is not a simple matter. The difficulties involved in diagnosing hearing losses in young children, as well as a general unawareness of the often serious effects that can result from a handicapping hearing loss, are the basic reasons for the lack of emphasis given to these matters. It is hoped that this symposium will be the means of stimulating a more positive approach to the over-all problem.

The extent of the problem may be determined from a report by Landis[2] that in 1952 in the public schools of Pennsylvania there were about 50,000 children with defective hearing. In Philadelphia alone 4 per cent of the children tested showed significant hearing losses. A report covering 98 public schools in Chicago[5] showed that 2.8 per cent of the pupils had a loss of 30 decibels or more for two or more frequencies in the speech range. An important aspect of studies such as these is confirmation of the fact that without routine periodic hearing tests in the schools often neither the teacher nor the parents suspect a hearing loss in many mildly and even severely impaired children. The report on the Philadelphia school children indicates that almost 80 per cent of the cases of impaired hearing discovered were characterized as conductive hearing losses, which suggests that the majority of such cases could

either have been prevented or cured if detected and properly treated early enough.

The high incidence of mild or even moderate hearing loss in children below the age of six is not fully appreciated because such losses in preschool children often go unrecognized. In 54 per cent of the cases found in the Chicago audiological screening clinics[5] to have a moderate loss or a severe loss of 35 decibels or more for the speech frequencies, even the children's own parents had no suspicion of any hearing difficulty. While the great benefit to be derived from routine testing in a school hearing conservation program is apparent, an adequate testing program for the preschool child with symptoms suggesting deafness would also be most valuable.

It is becoming increasingly evident that hearing defects are important medical problems not merely because of their high incidence, but more so because of the severe repercussion that a hearing impairment may have upon the personality of the child. Many children, unable to hear all that goes on in the classroom, are compelled to repeat grades when their actual ability to do the work would be adequate if they could hear. Other children begin to feel they do not fit in with their classmates, and they, therefore, develop various forms of antisocial behavior which create serious and often unrecognized problems both at home and at school. Such children are often incorrectly diagnosed as being dull, mentally retarded, aphasic, psychologically disturbed or even psychotic. The singularly severe effect that a handicapping hearing loss can have upon a personality places this problem in the foreground of medical importance.

For the pediatrician or general practitioner it is vital that in treating ear infections he does not become reliant on antibiotics alone. Though the incidence and severity of middle ear infections have been remarkably controlled by such drugs, there is growing evidence that despite excellent medical care a large number of children continue to have hearing losses after experiencing such infections.

Antibiotics are not always effective in preventing conductive hearing loss. The physician should constantly be aware of this possibility when treating such cases.

To provide the pediatrician with a general perspective of the field of hearing impairment and its concomitant problems is the purpose of this article, as well as to furnish him with a practical means of solving these problems in his own practice.

CONDUCTIVE AND PERCEPTIVE DEAFNESS

Hearing losses are classified into two types—conductive deafness and perceptive deafness—according to the site of the lesion responsible for the deafness.

In *conductive deafness* the site of pathology lies in or lateral to the footplate of the stapes such as in the outer or middle ear. This obstructs the conduction of sound waves to the inner ear. In *perceptive deafness* the lesion lies medial to the stapes and may include the inner ear, the eighth nerve or the higher centers. Distinction between the two types can be made from the results of hearing tests in association with the history and examination. There is also some therapeutic distinction, since conductive deafness has a far more favorable prognosis than perceptive deafness.

A patient with conductive deafness will have difficulty in hearing the sound emitted by a tuning fork when the tone is conducted to his ear through the air. But when the tuning fork is placed in direct contact with the bones of his skull (called bone conduction testing), the patient will hear the tone extremely well and often better than a person with normal hearing. When such a patient is spoken to loudly enough, he not only hears, but also has no difficulty in understanding what is being said (if he is old enough). Deafness produced by a conductive lesion is rarely more severe than 60 decibels, and even if it is present at birth it seldom is the cause of a significant speech disorder.

This is in contrast to congenital perceptive deafness, which is often accompanied by a speech disorder. Not only is the air conduction of sound reduced, but the bone conduction is also reduced and may even be entirely absent. Persons with perceptive deafness have difficulty both in hearing and in discriminating what is being said. Making the speech louder frequently does not improve the discrimination and may even make it worse. A hearing loss greater than about 65 decibels is usually attended by a defect in the perceptive mechanism.

HEARING AND SPEECH DEVELOPMENT

To understand the problems associated with hearing impairment in children, it is necessary to appreciate the intimate relation between hearing and speech development. Throughout infancy the child listens to speech, learns to associate sounds with meaningful information, and subsequently mimics what he hears. By the age of three a normal child has most of his speech patterns developed. But the child with no useful hearing will develop little or no intelligible speech spontaneously, because what he has never heard he cannot imitate. If he has a partial hearing loss accompanied by distortion, he will be able to develop a form of speech pattern which most likely will be defective.

When acquiring speech, a child learns to pronounce vowels and consonants and by combining them to form varieties of sounds that convey meaning. In our audible frequency range the vowels (a, e, i, o, u) are low tones, while the consonants are high tones. If a child has a

high tone hearing loss with little loss in the low tones (a common finding in children as well as adults), he will hear the vowels or low notes, but the consonants will be inaudible or seem distorted. Since a language has little meaning if only vowel sounds are heard, discrimination in what is being heard is often difficult in such cases.

Children who have difficulty in correctly pronouncing certain sibilant sounds, particularly "s," were in the past apt to be described as being "tongue-tied." Most such children are not in reality tongue-tied, but have a high tone deafness that does not permit them to hear the sibilant sounds in the high frequency range. A child with such a high tone loss may hear the sound of "s" as "t," and in learning to pronounce words to form speech he will repeat only what he is able to hear. If he does not hear accurately, he cannot repeat accurately what is said to him.

Our sense of hearing serves to monitor and control not only what we say, but also how we say it. It tells us whether we are speaking loudly or softly and informs us of other quality characteristics in our own voices. It also makes us aware of our own enunciation. When this monitoring or feed-back system is not functioning properly, many factors may be affected in our speech.

If the hearing monitor is not present during infancy and childhood (as in profound perceptive deafness), such speech as the child may be able to perform will lack control of most of the recognized qualities. If the hearing monitor system is impaired after speech patterns have been established, there often occurs a deterioration of voice and speech, with poor enunciation and slurring of words because the patient does not constantly hear his mistakes. He believes he speaks distinctly when actually he does not. In such cases training called "speech insurance" is helpful in preventing speech deterioration.

It should be pointed out that we hear our own voices not only through airborne sound, but also through bone conduction. As a matter of fact, when air conduction is affected, but bone conduction remains normal, as in conductive deafness, there is little effect on the voice or speech, because the bone conduction acts as a monitor control. When, however, both the bone conduction and the air conduction mediums for hearing are depressed, the patient has difficulty in hearing his own voice. He therefore often speaks loudly in order to hear himself. This in part explains the loud voices of some patients with perceptive deafness.

In some patients with excellent bone conduction the voice is often abnormally soft and low, because they hear themselves too well by bone conduction. If they actually speak in what the normal listener would assume is an ordinary tone, to themselves it seems as though they are shouting. They consequently soften their speech to a level which seems to be normal to them.

In many cases of perceptive deafness the monitoring system is itself

distorted, so that there is not only a loss of hearing, but also a distortion to the listener in the sound that is heard.

Children with high tone deafness present a most complex and often deceptive picture. Sometimes they seem to hear and understand well, particularly when they are looking at the speaker or paying strict attention, while at other times they seem to be inattentive and backward, especially under certain conditions not often apparent to the layman. Most of the adverse effects upon the child's personality have their origin in the distorted communication caused by such high tone deafness.

From this nucleus the development of abnormal behavior and maladjustment of the child to his immediate social community can be readily predicted. Most such children present behavior problems before the cause of their difficulty is recognized and understood, and the child properly treated. It is the responsibility of the pediatrician to be aware of the effects of hearing loss, to be able to detect it, and to know what to do for the child. It is also important that he be constantly aware of the considerable difference in the effect of a severe hearing loss if its onset is before or after the child has reached the age of three, when speech patterns have been reasonably well established.

COMMON CAUSES OF HEARING LOSS

Let us review briefly the most common causes of hearing loss in children, dividing them into two categories—those that are congenital and those that develop during infancy and childhood.

Among the common causes of congenital hearing loss are (1) inheritance, (2) maternal rubella and other infections occurring during the first trimester of pregnancy, (3) Rh incompatibility, with kernicterus, and (4) congenital abnormalities.

For orientation purposes a brief comment on the essential features produced by each of these causes is included. With the exception of obvious visible congenital malformations of the ears causing a conductive deafness, physical examination of the ears in most instances of congenital deafness reveals essentially normal findings. The lesion in such cases lies in the neural elements of the auditory pathway.

Inheritance

The most common form of congenital deafness due to inheritance is the severe perceptive loss that leaves the child with little useful residual hearing (Fig. 8). Such a child requires institutional training in a school for the deaf. Children with this type of loss are usually brought to the physician because of the absence of speech development and the

lack of response to sound. Sometimes these children are difficult to distinguish from youngsters with aphasia or psychiatric disturbances, but an accurate distinction as early as possible is obviously essential for proper management.

In Figure 9 is seen another important type of congenital inherited deafness—the high tone loss which is accompanied by a speech defect, particularly with the "s" sound. This type of loss is generally nonprogressive and irreversible. Its early diagnosis is vital to the normal rearing

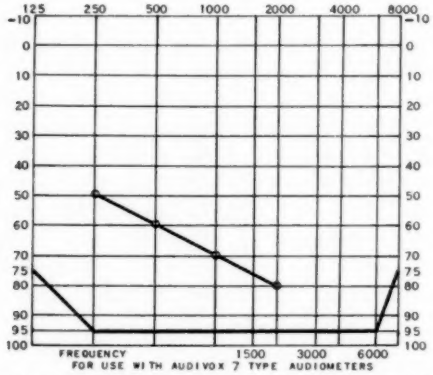


Fig. 8. Profound congenital hereditary perceptive deafness. (Normal hearing is around "0" db. in all frequencies. The greater the distance from the "0" db. line, the greater the hearing loss. The lower frequencies are on the left half of the audiogram and the higher ones on the right.) Any hearing loss in the better ear greater than 30 db. in the frequency range from 500 to 2000 usually requires the use of a hearing aid.

of the child. Such a child is one who is often accused of being backward or inattentive, and who insidiously develops into a behavior and social problem. He hears well, but has difficulty discriminating speech sounds. Unfortunately, present day hearing aids amplify sounds, but do not improve discrimination, and are only of minimal help in such cases.

Maternal Rubella

Maternal rubella in the first trimester of pregnancy (and probably other viral infections) can result in varying degrees of perceptive deafness. These may be mild or profoundly severe (Fig. 10).

Rh Incompatibility with Kernicterus

Figure 11 shows the classical type of hearing loss produced by Rh incompatibility with kernicterus. Almost invariably this is accompanied by athetoid cerebral palsy. The speech defect present in these children

Fig. 9.

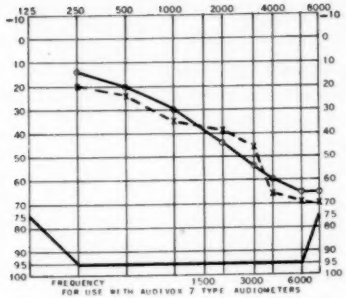
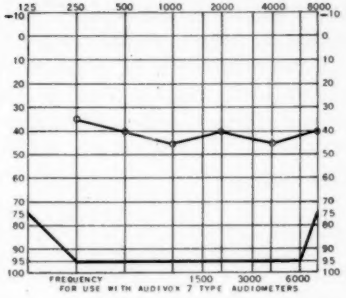


Fig. 10.



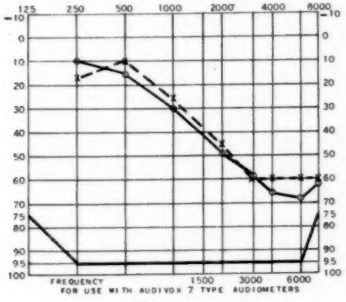


Fig. 11.

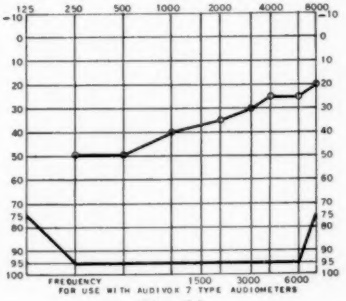


Fig. 12.

Fig. 9. High tone congenital perceptive deafness.

Fig. 10. Perceptive deafness resulting from maternal rubella during first trimester of pregnancy.

Fig. 11. Perceptive deafness caused by Rh incompatibility with kernicterus and athetoid cerebral palsy.

Fig. 12. Conductive deafness due to complete congenital aplasia of the external auditory canal.

is due not only to the cerebral palsy, but also to the high tone hearing loss, which is generally neither progressive nor reversible.

Congenital Abnormalities

Congenital abnormalities such as atresia of the auditory canals, malformed auricles, Treacher-Collins syndrome, and ossicular malformations produce a conductive type of hearing loss that is similar to the curve shown in Figure 12. If spoken to loudly enough, these children have little trouble hearing what is being said, and they experience no distortion or difficulty in discriminating. They also do not have marked speech defects. The bone conduction in these children is normal. In many instances these children can have their hearing restored by recently developed surgical procedures. I have lately seen three cases of

congenital fixation of the stapes in children below the age of 10, one of whom at the age of five had her hearing restored to normal by means of a stapes mobilization.

Sometimes there are multiple congenital defects involving also the neural mechanism of hearing. This causes a perceptive loss with the bone conduction either reduced or entirely absent.

Other Causes

There are many other causes of congenital deafness, such as syphilis and drug toxicity, but the most common ones encountered in pediatric practice have been described. Congenital losses are important because they can affect the development of speech and can lead to many per-

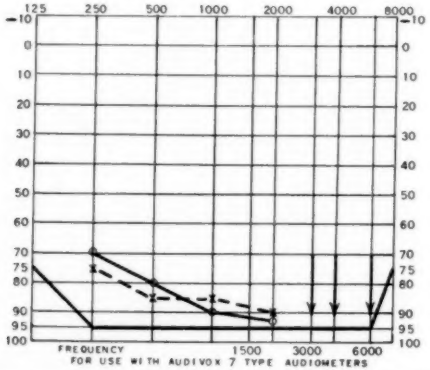


Fig. 13. Severe perceptive deafness caused by excessive use of neomycin.

sonality and emotional disorders. To prevent such disorders it is essential that a correct diagnosis be made and corrective measures instituted as promptly as advisable. The physician generally has the initial responsibility not only of detecting the presence of such a hearing defect, but also of seeing that a definitive positive diagnosis is established and therapy begun.

During infancy and childhood the most frequent causes of deafness are anoxia, drug toxicity, diseases, trauma, inheritance, hypertrophied adenoids. Even a hasty perusal of these cases indicates the importance of preventive measures and the vital role that must be assumed by the physician in treating children.

Anoxia. Anoxia following birth has been known to produce a perceptive high tone type of hearing loss similar to that shown in Figure 11.

Drug Toxicity. Figure 13 shows the profound deafness produced in a three year old child after excessive use of neomycin. Streptomycin can also cause a similar loss in hearing.

Diseases. Among the diseases that can produce hearing loss in children are scarlet fever, meningitis, measles, otitis media, intracranial neoplasms, and the high fevers and convulsions accompanying infections. Mumps is probably the most common cause of unilateral deafness encountered in practice. Deafness in one ear can go unnoticed for many years, particularly when the deafness occurs in the right ear, since most people use the telephone on the left ear, holding it with the left hand in order to leave the right hand free. Sometimes it is not until the child or even adult tries to use the telephone on his right ear that he becomes aware of the hearing difficulty even though it may have been present for years. It is not unusual for a person so unknowingly con-

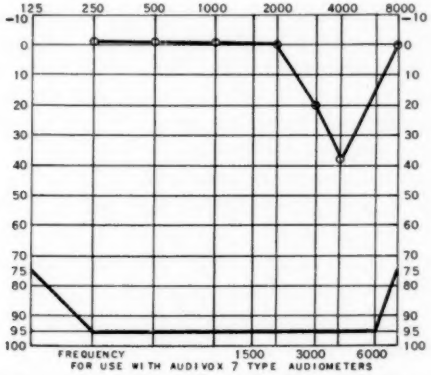


Fig. 14. Mild auditory defect due to exposure to the acoustic trauma of cap guns.

ditioned to having only one useful ear to feel that his loss occurred suddenly at the time he first discovered he could not hear when using the telephone.

Trauma. Figure 14 shows the hearing loss which resulted in a child aged nine due to exposure to cap guns.[3] This is usually accompanied by a ringing tinnitus which, when it subsides, leaves some high tone deafness. Firecrackers exploding close to the ears and pistol fire may cause this type of hearing loss in children as well as in adults. Direct trauma to the head such as from falls and head blows may also produce this kind of hearing loss, to a much greater degree. There may be no visible damage to the eardrum or middle ear, and there may be no evidence of fracture in the temporal bone. Shucknecht[4] showed that a blow to one side of the head can affect the hearing of either or both ears, by damaging the inner ear itself.

Inheritance. There is a severe kind of inherited deafness which begins in early childhood or adolescence and progresses until little useful hearing remains. Figure 8 is similar to the audiogram of one such child

in a family in which eight known members had normal hearing until the age of about nine or 10, after which insidious severe nerve deafness developed over a period of a few years.

HYPERTROPHIED ADENOID. The most common cause of conductive deafness in children is hypertrophied adenoid tissue. The high incidence of hearing loss in children with hypertrophied adenoids, particularly when there is an accompanying history of mouth breathing and ear infection, is not fully appreciated because routine hearing tests are rarely done on such children below the age of six.

In an investigative report now in publication the author performed comprehensive hearing studies on 100 children referred for ear symptoms and found that over 90 per cent of the conductive hearing losses were associated with adenoid hyperplasia. About 35 per cent of the cases gave histories of previous tonsillectomy and adenoidectomy, but the symptoms were not cured either because of adenoid regrowth or inadequate surgery. It was furthermore demonstrated that the vast majority of these hearing losses are reversible and curable if a careful adenoidectomy under direct visualization is directed to the removal of all possible adenoid tissue behind both eustachian tubes. *Adenoid abnormalities and the indications for their removal relate only to cases of conductive deafness* and not to other types. It is also judicious to point out that many cases of conductive deafness due to hypertrophied adenoids can be obviated by early attention with antibiotics, myringotomy, allergic control, proper humidification of air and prevention of otitis media following acute rhinitis.

With this brief review the pediatrician has at his command, not all, but most of the common causes of hearing loss in children.

HEARING TESTING BY THE PEDIATRICIAN

A reliable quantitative hearing study of a young child is often most difficult. With younger children it is often not possible to obtain even reliable air conduction tests, let alone bone conduction and speech tests. The principal responsibilities of the pediatrician are (1) to be on the alert for the possible presence of a hearing loss in his patients and (2), when the findings are suspicious, to determine whether more definitive studies are warranted. The practicing physician is rarely equipped to obtain a quantitative threshold and definite diagnosis. Since the solution to the over-all problem of deafness, however, depends upon its early detection, the main responsibility necessarily rests with the practitioner.

There are many methods by which the physician can determine whether deafness is a reasonable etiologic possibility. One method is

to secure an accurate history. For example, a child who never answers or comes when he is called from another room, but does react when he can see the face of the caller, could possibly have impaired hearing. It is important in such instances to determine carefully whether the calling is done by voice alone and is not accompanied by stamping the foot or banging on a table. The child who cannot be awakened by speaking to him in a loud voice should be considered in need of hearing testing, especially if he also presents retarded or defective speech development. Since similar negative responses are often obtained from emotionally disturbed children, careful distinction is essential through hearing studies, as well as other consultations.

Another method is to attempt to have the child respond to certain noise makers. It should be borne in mind, however, in examining some children below the age of five that clapping hands behind the child's back, stamping feet, or banging a pan in order to observe his reaction is not always a reliable indication that he can or cannot hear. Should he respond, it may be because he feels the sound vibration. If he fails to respond, it may be for a variety of psychological reasons, although normal hearing is present. If a child has some useful hearing and a strongly vibrating tuning fork of 512 cycles is surreptitiously placed near one of his ears, he may either turn in the direction of the tuning fork or exhibit some other sign that he hears. Hand bells may also be used behind the child's back to see whether he consistently turns around when they are sounded. A positive response by the child to carefully conducted noisemaking tests is generally reliable, but the pediatrician needs to be aware that in such tests a negative response does not always indicate the absence of hearing.

Whenever the physician has any indication that a hearing loss may be present, he should seek for a more definitive and quantitative evaluation. Whenever a child's speech defect involves the enunciation of sibilants, thorough hearing tests should be performed. This often takes not only considerable time and patience, but also special training and equipment. Often it should be done by an otologist or audiologist equipped to perform such studies.

In reply to the question often asked, "How old must a child be before his hearing can be tested?" it has been conclusively demonstrated that an accurate hearing threshold can be obtained on some children as young as six months. I obtained an accurate test on a four-month old child, and its reliability was confirmed three years later. This demonstrates that parents should never be told that a child is too young to have his hearing tested if there is sufficient need for such a study. When deafness is suspected, the advice that it is best to wait until the child is older, since nothing can be done about the problem anyhow, is un-

fortunate and not in the best interests of the child or his family. The earlier a hearing defect is detected and treatment begun, the better.

HEARING TESTING BY THE OTOLOGIST

Since all hearing tests performed in office practice require a subjective response from the patient as well as his voluntary cooperation, most such tests have limited application for infants and children too young to cooperate fully. There is as yet no single reliable objective test of hearing. It is necessary, therefore, for the otologist to perform a battery of tests, the results of which, combined with the child's history and examination, can provide a reasonably accurate evaluation of the child's hearing status. These tests include speech reception testing, conditioning such as with a peep-show technique, the use of calibrated noisemakers, and the psychogalvanic skin resistance test (PGSR). The last is the most valuable of these tests, since it often gives an accurate hearing threshold with the least cooperation required on the part of the patient.

Speech Reception Test

In the speech reception test the child is placed in a quiet room containing a loud speaker and earphones. The tester is in an adjoining room from which he can watch the child's reaction through an observation window. By speaking through a calibrated instrument that controls the loudness of the speech reaching the child's ears, the tester can often determine how loud his speech must be for the child to give some sort of definite response. If the child fails to give consistent responses, however, it does not necessarily follow that he has no hearing.

Conditioning Tests

There are numerous types of conditioning tests such as the peep show. Here the child must be rather cooperative. He is conditioned to respond to sound by associating each sound stimulus with a pleasant visual experience. Finally the visual stimulus is not presented, and the child will then respond solely to the auditory stimulus if he hears it and has been conditioned properly. Like other conditioning tests, this requires considerable time, skill and intelligent cooperation.

Psychogalvanic Skin Resistance Test

The psychogalvanic skin resistance test was developed by Hardy and Bordley.[1] It is presently a most useful procedure in some children and

infants who can otherwise not be studied. Its reliability in proper hands has been established beyond doubt, but is not always definitive in all children, for a variety of reasons. It must be viewed as another supplementary test to be correlated with other findings. The cooperation or voluntary response of the subject is not required. In many instances the test can be completed in less than an hour. The services of at least two people are required to perform the test properly so that the experience is not unpleasant to the child. The testers must be experienced with children and also aware of the electronic and psychologic pitfalls inherent in this technique.

In brief, the child is taught to accept a set of earphones on his head, two small electrodes on his fingers and another pair on his leg. He is then carefully conditioned so that each time sound is introduced into his ear, it is followed a second later by a mild shock to the calf of his leg. The shock must be almost imperceptible to the child and should not cause any obvious discomfort. The shock produces a change in sympathetic nerve activity causing increased skin perspiration and reduced skin potential, which is then conducted from the finger electrodes to a recording device. When the child has been adequately conditioned, the shock is stopped except for reinforcement purposes, and the change in skin resistance continues to respond to the sound alone. In this manner, by reducing the intensity of the sound in the ear until at one level the skin resistance is affected and at just a weaker level it is not affected, it is possible to obtain a complete audiogram on most children.

Careful interpretation of the results of all hearing tests provides the otologist with his evaluation of the hearing acuity of the child. Since deafness is often only one of multiple problems, it is necessary to correlate the otological findings with other evaluations, probably psychological and psychiatric. The role of each must be carefully taken into account.

TREATMENT OF HEARING DISORDERS

Deafness is a symptom of some pathologic process involving either the conductive or perceptive mechanism of hearing. Consequently, treatment should be directed against the underlying cause and should be instituted as early as possible to prevent permanent impairment and complications.

The pediatrician can do a great deal to prevent the high incidence and severity of hearing losses in children. Early detection and an accurate diagnosis, for example, can go a long way in helping a child to develop as normally as possible and to obviate social and behavior

problems. Potentially neurotoxic drugs such as streptomycin and neomycin should be used judiciously so that deafness will not result. Families with prominent strains of deafness should be guided in their marriage plans. Pregnant women should be cautioned against vaccination and exposure to certain diseases during the early months of pregnancy. Anoxia should be avoided and high fevers and convulsions treated intensively.

Conductive Deafness

The conductive type of hearing loss is the more suitable for definitive medical treatment, and generally the loss can be completely cured or considerably improved. Depending on the cause, the following procedures may be indicated: adenoidectomy; irradiation to the nasopharynx; eustachian tube inflation; treatment of otitis media, sinusitis or allergies; reconstructive surgery; tympanoplasty; stapes mobilization; or fenestration.

In treating infections of the middle ears the physician should keep in mind the importance of intensive and prolonged antibiotic therapy, as well as the surgical principle of incision and drainage where there is loculated pus, as in an attack of acute otitis media with a bulging eardrum. Frequently, expert handling of such cases will prevent moderate degrees of conductive deafness. Similar emphasis should be placed on a careful adenoidectomy, when it is indicated. Just because a child has had a so-called tonsillectomy and adenoidectomy does not necessarily rule out hypertrophied adenoids as the cause for persistent ear symptoms and conductive hearing loss. It is essential that the adenoids be properly removed. There may be adenoid tissue left in vital areas behind the eustachian tubes, or a marked regrowth as in allergic children, or even extensive scar tissue and damage to the eustachian tubes from adenoidectomies performed without adequate exposure or without regard for anatomical structure.

Whenever the indications for mastoidectomy are to be evaluated, the hearing status must be given high priority. The type of operation performed should not only clear the infection, but also preserve as much hearing as possible.

It is also now possible to close most perforated eardrums by tympanoplastic procedures and improve hearing in many distorted middle ears. The author has performed a number of these successfully even in children.

The pediatrician can prevent the important complications of hearing loss by forthrightly explaining the problems to the parents and assuming the role of guide and advisor to the parents and child in their efforts to compensate and adjust to the hearing handicap.

Perceptive Deafness

With perceptive deafness, for example, the pathologic process is generally irreversible. There is no incontrovertible proof, as yet, that any available therapy can restore the function of damaged perceptive neural elements in the ear. Nevertheless, a great deal can be done to help children with handicapping perceptive deafness, and in such cases the pediatrician must assume a greater responsibility. It is essential to inform the parents why medical or surgical treatment is presently ineffective and why all efforts should be directed towards rehabilitation rather than to seek a nonexistent cure and expose the child to needless medical and surgical treatments.

First, *our primary interest is not in how much hearing is lost.* We are interested in how much hearing exists and what can be done to help the child use most efficiently what hearing he has. We have found it unwise to tell a parent that her child has lost a certain percentage of his hearing. It is far more effective to say that the child has lost some hearing, but that a certain quantity of hearing remains that can either be corrected medically or surgically, or made much more useful with a hearing aid and special training procedures. The atmosphere which the physician should create should be positive rather than negative. The standard audiogram chart unfortunately records in decibels of hearing loss, but it is not advisable to explain it in such a negative manner to the patient and his family. The real purpose of all hearing tests is to determine how much hearing is present.

Auditory Rehabilitation

All youngsters with sufficient hearing loss which interferes with their ordinary communication should receive, in addition to medical treatment, some form of auditory rehabilitation if their loss cannot be corrected. Usually a 30 or 35 decibel hearing loss in the speech frequencies in the better ear or a marked high tone loss is considered sufficiently handicapping to interfere with communication. Such children must be taught to listen actively and to pay strict attention to all sounds. They must be carefully instructed how to get the most out of their residual hearing. The early application of a hearing aid and training in its use will often demonstrate to hesitant parents the realistic value of this type of approach and obtain their wholehearted support and cooperation.

Hearing Aids. The hearing aid should be used with an individually molded ear piece placed in the ear which will give the child the most effective hearing. This may sometimes be in the worse or better hearing ear, depending on the degrees and types of hearing loss present. Bone conduction hearing aids have limited use, and are primarily for use in

the presence of complete atresia of the ear canals or for chronically discharging ears.

When deafness is established in an infant or young child, it will usually be of the perceptive type, and amplification will generally be necessary. Though from a medical standpoint the terms "deafness," "hard of hearing," "hearing impairment," and "hearing loss" are used interchangeably and have essentially the same meaning, in educational circles the specific term "deaf child" is restricted to the child who has no useful residual hearing. Even a powerful hearing aid is of no use to such a child, and institutional training is required. The term "hard of hearing child" is applied by educators to those who have some useful residual hearing.

Little delay should be made in providing maximum use of the residual hearing. Many authorities in the field apply individual aids as early as possible. The author has treated several children two years old who managed extraordinarily well with their own hearing aids. There is some evidence that even infants whose deafness has been definitely established will benefit by having amplification. This can be accomplished by the use of a loudspeaker system or by placing on the infant's head, when the mother speaks to him for any extended time, a helmet such as a plane pilot might use into which has been built a set of earphones. Exposure to the rhythm of music and the constant sounds of speech are important experiences for the infant and young child with a marked hearing loss.

Speech Reading. If the hearing loss is not completely compensable with a hearing aid, the child should be taught speech reading. This includes the coordination of lip reading, the interpretation of facial expressions, and an intuitive grasp of the conversational trend. Psychological guidance is of extreme importance for the hard of hearing youngster and his parents.

SUMMARY AND CONCLUSIONS

More applicable to deafness than to almost any other handicap is the comment in the Foreword of this symposium that states, "Emphasis will be upon the child with a handicap and not upon the handicap itself." In expressing this same thought in otological concepts, it is felt that attention should be given not only to the ears, but even more so to what lies between them. Since comparatively little can be done to cure a perceptive hearing loss, attention must be directed towards mitigating the handicap by teaching the patient every possible manner in which he may compensate for his defect. It can be stated categorically that practically every child with a handicapping hearing loss can be helped.

The object of all hearing tests is not principally to obtain a diagnosis, but rather to be able to determine the best method of curing the deafness or of helping the child. If a child has a hearing loss, it is injudicious to suggest to the parents that they wait, since perhaps the child will grow out of it. This will rarely happen without adequate medical attention.

There are presently too few facilities that can aid the infant or preschool child and his parents with the problems of deafness and speech development. Many more are needed. A number of national organizations can be of service in such cases, and the parents should be invited to write to them. Among the foremost are the John Tracy Clinic Correspondence Course, 924 West 37th Street, Los Angeles 17, California; The American Hearing Society, 817 14th Street N.W., Washington 5, D. C.; The Volta Bureau, 1537 35th Street, N.W., Washington 7, D. C.

The American Academy of Ophthalmology and Otolaryngology, through its committee on Conservation of Hearing, has been endeavoring to educate both the public and the medical profession to the importance of early recognition and adequate treatment of the hard of hearing child. As an essential component of its program, it has urged the establishment of clinics throughout the country where these cases could be properly cared for. In some states a really comprehensive program has been developed.

Though otological services may be obtainable in the larger urban centers, the reverse is true for the predominantly rural areas. This emphasizes the need for regional clinics to which cases in these areas may be referred. Each clinic should provide a comprehensive service, including both medical and rehabilitative therapy. Detection clinics are helpful in screening cases found defective in group testing, but practical results come only from a program that actually provides the indicated treatment.

More than in most handicaps, the hard of hearing child requires the integrated attention of a team of specialists. One person cannot possibly diagnose, treat, rehabilitate, and guide the parents and child in their efforts to overcome the communicative handicap imposed by deafness. It is the responsibility of the pediatrician to act as the coordinator of the team, which frequently includes the otologist, audiologist, speech therapist, psychologist and even psychiatrist, as well as social workers and others.

In brief, the pediatrician who suspects the presence of a hearing loss in a child should first refer the child for quantitative hearing tests and an accurate diagnosis as to the cause of the deafness. He must then determine whether the hearing loss is curable and what measures are necessary to cure it as soon as possible. If the loss is irreversible and a hearing aid can help, a suitable one and training in its use by an audi-

ologist should be advised. Speech therapy should be given by a teacher who is well aware of the deafness aspect and knows how to use amplified sound. If there is a psychological problem, a trained psychologist should be asked for an evaluation. The pediatrician must always be available to guide and support the parents and child during the trying months of adjustment.

Every effort should be made by all concerned to start training early and to bring up the child in an environment as normal as possible, making excellent use of all methods of communication and utilizing his residual hearing most effectively. The emotional stability of the child and his parents, not only the hearing problem, must receive farsighted attention.

Hearing defects in children and the problems of the hard of hearing child are basically problems in preventive pediatrics. Their solutions are within practical reach and depend to a great extent upon the physician practicing pediatric medicine.

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READING DISORDERS

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Approximately one child of every 10 in our schools today does not read at levels which might be expected in relation to his ability and experience. This means that 4,000,000 children, of average or better intelligence, are retarded in learning to read. Their difficulties range from the mildly deficient to the absolute nonreader. The ratio of boys to girls presenting this disorder is approximately six to one. Many reasons for this sex difference have been postulated, but present evidence does not fully explain it.

Reading disorders are not new. There are historically early references to them in a variety of scientific records. They have been classified as aphasic, neurologic, psychogenic, educational or psychologic, and multiple etiologies have been hypothesized. The fact is, as in the stuttering syndrome, that reading disorders continue to demand further research. The problem is international; the UNESCO studies reveal a similar incidence in England, the Scandinavian countries and other parts of Europe.

Reading, and learning to read, is a complicated task. There is no automatic transition from perception to conception. The reading process involves the sensory modalities and a great part of the central nervous system. A complex of psychologic integrations comes into play, and the entire personality organization controls and directs attitudes and reactions about reading. The more insight we gain about the act of reading, the less tenable becomes a casual attitude, and the less we can be satisfied to admit a comfortably plausible rationale. It is apparent that no one scientific discipline has "all the answers" at this time.

Mastery of the "mechanics" of reading is fundamental. Herein is required facility in accurate perception of symbol forms, spatial orientation, and of the spatial and temporal sequences of letter orders. Second is the important skill of efficient association of sounds with symbols, and vice versa for spelling. Difficulties in mastering these skills

predominate in the early reading problems. Perceptual confusions (these are not peripherally, but centrally located) such as "but" for *tub*, or "was" for *saw*, and "felt" for *left* are presented intermittently. These errors have been termed "mirror reading" or "strephosymbolia," and such "reversals" have usually been assigned an organic etiology. Recent research shows, however, that such anomalies may be psychogenic. In the primary stages of learning to read these errors are prevalent, but when they persist, they must be considered symptomatic, and diagnostic study is warranted.

Many children may master these initial skills and thus can be expected to proceed from perception of single words towards organization of words into meaningful units and ideas. Certain error patterns, however, may now appear to hinder their efficiency. These consist in omissions of words from the sentence, additions of words of the child's own choosing, or substitutions such as "boat" for *ship*. Again there may be evidences of evasion such as the child who stoutly denied he could read "sugar," but promptly offered a full definition of it. Often these are children who have become good "word callers," but who comprehend little of the material they are "reading." The error patterns described in this paragraph are usually psychogenic.

Certain interdependent conditions must prevail if a child is not to experience initial difficulty in learning to read. These conditions are usually prerequisite to most learning success, but are particularly specific to acquiring the complicated skills of reading. Research and experience prove the following as necessary:

1. Good general health
2. Adequate background of social and environmental experience
3. Average, or better, intelligence
4. Accurate monocular or binocular vision for the usual reading distance
5. A cerebral cortex which can efficiently perceive letters and letter orders, and associate their concomitant phonetic values
6. Personality dynamics which will enable and motivate the child to perceive adequately, and to deal effectively with the frustrations and adjustments of individual and group learning situations
7. Skilled teaching and proper teaching conditions.

When informal or standardized educational tests reveal a child to be retarded in reading success, thorough evaluation is imperative. Each of the foregoing seven points should be evaluated along with an analysis of the child's whole educational pattern and experience. Individual tests of intelligence, of reading, spelling and arithmetical proficiency are necessary. Tests of the child's personality organization should be made via deeply searching projection tests, not by superficial "inventories" of a question and answer type. Exploration of his parental and sibling

relationships, and the cultural milieu, is essential. Knowledge of his health and developmental history is integral. The total should be viewed for possible endocrine or cortical dysfunction.

The foregoing are the minimal diagnostic criteria. Whether the child is at the stage of "learning to read" or "reading to learn," whether he is in elementary or secondary school, these are the factors which must be differentiated. To omit or hold casual attitudes towards any one element can result in a biased diagnosis with a consequent therapeutic program based on a faulty rationale.

From an etiologic standpoint reading disorders may cut across several disciplines. Such difficulties should always be viewed as a *syndrome* by all concerned. Such deficiencies may prove to be actually no more than a concomitant of intellectual retardation. In the normally intelligent child several factors may combine to produce a problem. Faulty vision is low on the list as causative. There is less and less evidence to support Orton's theory of delayed unilateral cerebral dominance, with mixed motor laterality as clinically symptomatic. There are almost insignificant differences in children who do or do not learn to read well, presenting "mixed dominances" between preferred eyedness and handedness. On the other hand, recent studies are revealing an increasing number of children whose etiologic picture does present neurogenic dysfunction in the form of generalized cortical dysrhythmia. In such case appropriate chemotherapy has often proved beneficial in helping the child achieve better integration and intellectual organization.

Personality problems are often an accompaniment to learning failure. In the field of reading disorders emotional difficulties are more often a *primary* cause than a reaction to the reading retardation. The clinical psychologist may find one, or a combination of, the following personality patterns:

1. The overconforming, inhibited, "too good" child, whose only recourse is to *please* the adults in his world. His distorted motivation sends him through the "motions" of learning in perfunctory, nonassimilating fashion. He is the victim of a "Momma knows best" philosophy.
2. The passive, dependent youngster whose training leads him to adopt a childish, hedonistic stance toward all things. He cannot tolerate the frustrations of learning, he has no perseverance, and pursues his wants indiscriminately.
3. The youngster whose parents really do not want him to grow up. He is the Peter Pan who lives in his infantile world of make-believe. He wants always to play, he brings his toys to school, he does not test reality.
4. The restless, resistive, contrary child who negates all efforts to train him. He uses nonlearning as a revengeful weapon, he re-

jects words. Occasionally this child may hide his passive aggressiveness under a "show" of apparent conformity.

5. The child who turns his aggressiveness against himself in masochistic fashion. He cries, "I'm dumb," or, "I want to, but there's something the matter with me and I can't."

There are many other contributive psychologic factors of less notable frequency which limitation of space forbids discussion of. Underlying these symptoms, however, are often serious, and deeply embedded, personality disorders requiring psychiatric management of both the child and his parents.

When your patient is reported to have difficulty in learning, the indicated course is to refer him for psychologic and educational evaluation. The more eclectic this study, the more assurance you may have of establishing a sound therapeutic program. Children with reading disorders usually require a "team approach" involving cooperation and coordination of physician, psychologist, educator and parents.

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MUSCULAR DEFECTS

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Since the great majority of muscular defects occurring in children produce chronic handicapping conditions for which the treatment is largely supportive and symptomatic, the general practitioner and pediatrician find that their most effective services are those that are directed at prevention of such defects. This is both economically and scientifically sound. The physician can be effective to some degree in the prevention of the primary handicapping condition and frequently to a greater extent in the prevention of the development of secondary handicaps.

PRIMARY PREVENTION

The cause of many conditions that result in muscular disability is recognized. It has been pointed out in previous clinics that certain preventive measures which are accepted as part of good medical practice are effective in reducing the incidence of long-term chronic illness in children. Those that are particularly concerned with primary prevention of neuromuscular defects include the following:

Good prenatal care
Qualified obstetric care
Adequate pediatric care of full term infants
Prevention of prematurity and special care of the prematurely born infant
Prevention of kernicterus
Immunization against communicable diseases for which a suitable agent is available
Protection from infection and adequate treatment of infections when they occur
Protection against accidental injuries and poisoning.

SECONDARY PREVENTION

The pediatrician has a great responsibility in attempting to prevent secondary complications in the child who already has evidence of a muscular defect. This is perhaps most obvious in the varied group of conditions included under cerebral palsy, in which multiple handicaps

are the rule rather than the exception. Prevention of secondary handicaps is also important in poliomyelitis, muscular dystrophy and in the less common metabolic and degenerative diseases of muscle. Such secondary complicating factors that can in general be prevented fall into several categories.

Nutrition and Diet

The handicapped child deserves the same general pediatric care that other children should receive to maintain good health. Children with injury to the brain resulting in alteration of normal muscle tone frequently present problems in the field of nutrition and diet. Many are feeding problems during infancy, and as a result their general growth and nutrition suffer. Attention to details of feeding is most important. Frequently, concentrated foodstuffs must be used to assure an adequate caloric intake. Because of difficulty in chewing and swallowing, many children do not readily take a diet that affords an adequately balanced intake. The protein and mineral content of the diet is frequently insufficient. Many children who are hyperactive require extra calories in the form of carbohydrate to balance their greater energy expenditures. Many older children, on the other hand, who are relatively inactive must have the carbohydrate in their diet restricted to a point at which there is not excessive weight gain. Some infants who are feeding problems are kept on a milk diet beyond the point at which this alone constitutes an adequate intake, and as a result iron and other deficiencies are likely to develop.

Prevention of Infection

All handicapped children deserve the same protection from communicable diseases as do other children. Perhaps there is a greater need for their protection than for protection of children who are otherwise well.

Sensory Defects

It is important to recognize in children with muscular disability other possible defects that may be correctable with early and adequate treatment. In the group of children with cerebral palsy there is a high incidence of sensory defects and of seizures that are amenable to treatment. Presence of several defects, including apparent mental retardation, should not be a reason for ignoring treatment of any defects that can be corrected. This applies particularly to visual and hearing defects, which have been discussed in some detail elsewhere. The early cor-

rection of these defects is particularly important to improve the child's ability to respond to stimuli and so aid his normal growth and development. Many children with motor defects that may in themselves be either mild or severe can be helped to lead much more normal lives and to develop into more competent adults if every attention is given to the correction and treatment of their associated handicaps.

Contractures

Many muscular disorders of children result in contractures that can be prevented or minimized with early treatment. Such contractures are the result of altered physiology of various sorts and are a problem throughout the period of growth, but early recognition of their crippling effect should lead to adequate treatment and fewer problems in those who survive the first two decades of life.

Psychologic Handicaps

Another field in which the pediatrician should have a large part is in the prevention of psychologic handicaps associated with the defective child. He has the responsibility both to the child and to his family. It is perhaps even more important that children with a handicap be encouraged to develop good habits that will lead to social acceptability and to the development of a maximum degree of independence than is the case with their normal peers, who do not have to cope with the problems of looking and being different. It tests the art of medicine to help parents avoid creating a situation in which emotional crippling of the child will be inevitable. Their feelings about being parents of a defective child and their varying reactions to this unpleasant situation must be understood, and support must be given as needed to prevent seriously abnormal parent-child relationships.

EARLY RECOGNITION

Early recognition of an abnormality of the neuromuscular system is important so that, if specific treatment is indicated, it may be instituted promptly, and, if none be available, that prevention of the secondary complications may be attempted. Many conditions present abnormal findings from the time of birth, but frequently the recognition of abnormal muscle tone or of a reflex change will not at once lead to an accurate diagnosis. The natural history of the disease makes observation over a period of time necessary in order to evaluate the total picture.

The differential diagnosis will not be discussed in detail other than

to emphasize its importance in relation to prognosis. Congenital defects of muscle groups, various types of myositis, the metabolic and degenerative diseases of muscle such as amyotonia congenita, myotonia congenita, myotonic dystrophy, the various types of muscular dystrophy, myasthenia gravis, familial periodic paralysis must be distinguished from congenital defects of the central nervous system and from acquired injury or infection of any parts of the nervous, skeletal or muscular systems.

Except in the rare cases in which specific therapy is available, the treatment is symptomatic and supportive. An understanding of the altered physiology and of the changes associated with growth and development will dictate the principles of treatment if not the modality, and will lead to an honest skepticism as to the results of many "therapies." The orthopedist is perhaps most helpful in correcting structural imbalances and in modifying musculoskeletal defects.

This does not imply that an accurate and early diagnosis is not important. On the contrary, no valid plan or realistic approach is possible until a diagnosis is established and until an evaluation of both the liabilities and assets of the individual child has been made. In younger children many of the more valid observations must be made over a period of time in order to assess the rate of impaired growth and development and to evaluate function as it develops or fails to do so as a result of defective tissue.

A knowledge of the time and sequence of normal development of an infant and child is essential to the recognition and understanding of abnormal states. Variation in muscle tone and reflex changes together with slow rate of development are most significant changes. They should lead to a search for sensory changes and for evidence of growth failure.

MANAGEMENT

The various conditions resulting from brain injury or defect manifesting a motor disability that are grouped under the heading of cerebral palsy illustrate the complexities of adequate evaluation and logical treatment. Depending on the location and extent of the area of brain involved, there may be varying types and degrees of motor manifestation together with slight or severe involvement of the sensory system and of the intellect. Classification of these multiple handicaps, as made by Minear, leads to a more rational approach to the over-all management of the child.

The physiological or motor involvement reflected in changes in muscle tone is classified as spastic, athetotic of various types, rigidity, ataxic, tremor, atonic or mixed. The topographical classification identifies the

degree and location of involvement of the four extremities. The etiological classification includes prenatal factors that are either hereditary or acquired in utero, natal factors and damage during the postnatal period. Important supplemental classifications are made of the degree of mental deficiency, physical status including presence and degree of contractures, the presence and type of convulsive seizures, posture and pattern of gait, eye-hand behavior patterns, visual status, auditory status and degree and type of speech disturbance. The functional capacity is divided into four degrees of severity. The patients are classified from a therapeutic point of view into four groups, ranging from those requiring no treatment to those so severely involved that they require long-term institutionalization and care.

When, after a period of time and observation and testing, such classification as outlined can be made for a given patient, the way is opened for realistic planning and the setting of obtainable goals and treatment. It is obvious that adequate evaluation of the whole child as a functioning unit and not just of his motor status is essential to both diagnosis and to rational management.

Because of the multiple handicaps or of the severity of the intellectual involvement, perhaps a quarter of the children with cerebral palsy will need essentially supportive care during their life span. Every effort should be made to help each child to develop the greatest degree of self-help and of independence of which he is capable. The importance of the child's learning to ambulate unaided, to feed and to dress himself and to communicate cannot be overestimated from the point of view of the parents or institutional attendants. In half or more of the group, semi-independence can be achieved. If secondary complications can be avoided, probably more than a quarter of the group should be able to be independent and self-supporting.

It is almost impossible to predict with accuracy in infancy or even early childhood the ultimate status of patients with brain injury. All should initially be given the benefit of whatever help and training and treatment is possible. In general the quadriplegics with a history of major problems immediately after birth do poorly, while the hemiplegics as a group do well.

Physical therapy is of great value in many types of muscular disability. It should be prescribed in the light of altered physiology by a physician and be directed by a competent therapist. From the practical standpoint, parents should be instructed carefully in the technique so that daily care at home can be provided. In general the aim of therapy in lesions of a central origin is to prevent or minimize the effect of contractures and to encourage the development of close-to-normal patterns of movement. In peripheral lesions heat, massage and exercise are in general of greatest value.

The role of the pediatrician in these cases is not one of curing or of restoring to perfect health. He does have many responsibilities, however, and they continue rather than cease when he has made a diagnosis. His duties include:

Family Counsellor

He must interpret the findings and their significance to the parents. This can be done only at the rate at which they are ready to accept it. He must help them to understand their feelings and be a good counsellor by listening uncritically. He must help the family accept the handicapped child with his limitations and help the family provide an environment in which he will develop to the best of his ability rather than one in which he will be overprotected. The pediatrician must, when the occasion arises, interpret the genetic significance of certain diseases and help the family to draw their own conclusions from such objective evidence as can be presented. He occasionally must be an adviser in regard to temporary or permanent care for the child away from home when this is for the best interests of the child and of the family as well as of the community at large.

Pediatric Care

The handicapped child must be given all the benefits of good pediatric care that are needed by presumably well children. The pediatrician must be on the lookout for other defects and provide treatment for them as is indicated.

Coordination of Care and Treatment

The family physician or pediatrician must guide the family in obtaining and using the services of other specialists that are concerned with the problems presented. These include the orthopedist, ophthalmologist, neurologist, audiologist, psychologist and dentist. Because of his knowledge of the growth and development of normal children, the pediatrician can be effective in determining the timing of such other treatments as are indicated and of estimating their relative importance to the child as a whole. The pediatrician, above all, can contribute by providing continuity of medical supervision and of care.

Economic Factors

The family doctor can perhaps best realize the great expense that may be involved in the care of a severely handicapped child and can

help the family make most effective use of such community resources as are available. By showing genuine interest in the child and by judicious use of consultants he can minimize expensive shopping. He is mindful of the recreational needs of the child and of his family and of the problems involved in supplying special educational and training services. He is mindful of the perceptive and receptive difficulties that many children with organic brain injury manifest and is helpful in interpreting the child's behavior and learning difficulty to teachers and others with whom he comes in contact. When it is anticipated that the handicapped child can make a fairly good adjustment to life, the physician is helpful to the family and to the child in giving early thought to the vocational problems that will be encountered. He seeks advice where this is available and helps the child to develop good work habits early in life that will be valuable in any employment situation.

Emotional Problems

Since it is frequently not the handicap itself, but the emotional problems of the child and his family that actually interfere with the child's making as good an adjustment as possible in life, every attempt is made to minimize this complication. Acceptance of inevitable limitations, lack of self-pity, setting of realistic goals and self-understanding must be sought for.

Drug Therapy

Drug therapy for cerebral palsy is being thoroughly explored, but no satisfactory agent is at the moment available. Several relaxants will effectively relax spastic muscles, but it has yet to be satisfactorily demonstrated that more effective use can be made of these muscles when their tone is altered. Anticonvulsants must be used as indicated in children with seizures.

Surgery

Surgery is playing an increasingly important part in the correction of some of the defects of patients with neuromuscular problems. This is still limited largely to orthopedic surgery, but certain neurosurgical approaches aimed at removing irritable foci or interrupting nerve pathways which carry impulses of an unhelpful nature are showing some promise.

Principles enumerated here apply to the patient with poliomyelitis. His problems are usually different in that he has already acquired and

developed neuromuscular function before it was interrupted by infection. His problem is one of re-learning. Orthopedic procedures are of proved value to certain patients with residual weakness or paralysis as an end result of poliomyelitis.

There is as yet no drug that seems to be effective in altering the course of progressive muscular dystrophy. Progress is being made toward an understanding of the metabolic problems involved. In this condition the avoidance of contractures is most important, and probably the psychological stimulation to keep active is as effective as is any routine pattern of exercise.

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ORAL HANDICAPS

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"Little can be accomplished for grown-up people; the intelligent man begins with the child."—*Goethe.*

The preceding quotation, in the Journals of Dentistry for Children, is a constant reminder to the dental profession that the child is the key to national oral health. It is estimated that four and a half times the present number of dentists is necessary if the accumulated dental needs are to be eliminated by current dental procedures.[14] On the other hand, present dental manpower is adequate to maintain optimal oral health conditions once the backlog is eradicated.[15] Failure of dental manpower increases to keep pace with population increases has caused a steady decline in the dentist-patient ratio. Therefore an increase in dental manpower, the most obvious solution, is neither practical nor efficient. The need for more dentists can be reduced by improving the efficiency of the dentist through dental research and better utilization of auxiliary personnel, plus the application of more effective dental health education and preventive procedures.

Pediatrics is a special branch of medicine by virtue of the age group of the patients treated. It differs from other medical specialities whose chief interest is in a specific disease or function of the body. Inasmuch as the total health of the child is the central factor of pediatric medicine, oral health, being an integral part of the child's total health, should be of equal concern to the pediatrician. This is particularly true of oral health conditions originating during a period when the child is exclusively under pediatric care. The dentist is rarely consulted by the expectant parents or medical profession during prenatal care or infancy. Even the most important period of dental development, corresponding to eruption of the deciduous dentition and formation of the permanent teeth, finds the oral health of the child under medical guidance. This is proper, provided the child and parents receive proper guidance relative to the developing dental structures.

The dentist generally enters the life of the child some time after the

eruption of the deciduous dentition, which is completed about two years of age. Responsibility for oral health during the remainder of childhood is shared by the dentist and the pediatrician. Thus it is within the scope of pediatrics to reduce a proportionate share of the accumulated dental needs predictable for the future.

PROBLEMS OF GROWTH AND DEVELOPMENT

Congenital Malformations

A serious oral problem confronting the pediatrician is the newborn child with an oral congenital malformation. Ivy reported that one child in 770 is born with a cleft palate, cleft lip or both.[8] Most of these malformations are easily detected during routine examination immediately after birth. However, there are instances when the palatal aperture may be so small or so located that its perception eludes the examiner. Survival of the child depends on adequate nutrition during these first critical days. Palate or lip surgery is delayed until the child begins to gain weight and the physical condition improves. In the meantime, feeding is achieved by spoon, medicine dropper or special feeding apparatus.

The subsequent treatment is planned by a competent group of specialists, once preservation of life is assured and the infant begins to progress. Each member of this team has an interest in a particular phase of treatment of the cleft palate child. Surgical intervention is delayed until this team has an opportunity to examine the child, and study the history and findings. Participants in the cleft palate team include a pediatrician, psychologist, developmental analyst, otolaryngologist, speech therapist, oral roentgenologist, oral and plastic surgeons, pedodontist, orthodontist, and prosthodontist.[19]

The consequences of poor treatment planning are all too evident. Numerous ineffective palatal operations, with a resultant referral of the patient to a prosthodontist, usually predict an unfavorable prosthetic prognosis. Prosthetic treatment is hindered in these cases by heavy scar tissue stretched across the palate. Although surgery has closed the aperture or lengthened the velum, it is of little consequence if the musculature of the naso-oral passage is immobilized or insufficient pliable tissue remains.[5] Appearance is an important factor, but the child must be able to enunciate with clarity. Only by early recognition, then evaluation and planning by a competent team of medical and dental experts, will an effective service be rendered for the child with a cleft palate.

Eruption of the Deciduous Teeth

Parents of children with dental problems occurring between birth and complete eruption of the deciduous dentition usually seek the

services of the pediatrician. Then it is usually a matter of allaying apprehensions concerning the tooth eruption pattern of the child.

A variety of undiagnosed symptoms are erroneously attributed to tooth eruption. Irritability and slight temperature elevation are common. The discomforts of tooth eruption are not easily mitigated. Most discomfort accompanying tooth eruption results from pressure on the tissue at the root apices of developing and erupting teeth.

Lancing of the gums is avoided if further discomfort and complications of eruption are to be prevented. Eruption of the teeth progresses intermittently. Lancing the gum during one of these intermediate spurts permits the tissue, during the ensuing rest period, to form a cicatrix which poses a problem more serious than the original condition.

Prolonged Retention of Deciduous Teeth

The eruption and exfoliation of deciduous teeth follow a general pattern within certain time limits. Aberrations must be recognized

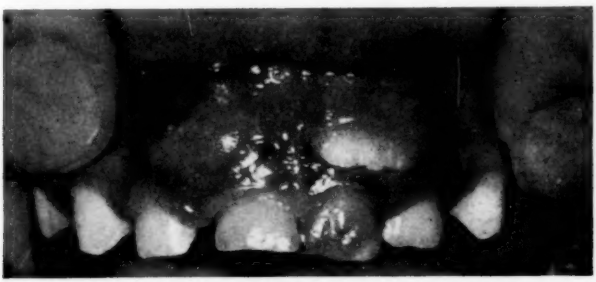

Fig. 15. Labial deflection of the erupting left central permanent incisor caused by the prolonged retention of the unresorbed deciduous incisor. Both deciduous central incisors are nonvital; therefore the proper time to remove the deciduous incisors should be determined by roentgenographic examination.

early or the entire eruption pattern and alignment of the deciduous and permanent dentitions is jeopardized. Prolonged retention of a deciduous tooth can result in deflections or impactions of the succedaneous teeth. The resulting condition may not be correctable, and removal of the offending tooth creates a problem of occlusal equilibrium.

A nonvital, uninfected deciduous incisor resorbs at a slower rate than the corresponding tooth on the other side of the arch; frequently it does not resorb at all. Thus the eruption path of the permanent tooth is blocked or the permanent tooth is deflected, as illustrated in Figure 15. The nonvital tooth is extracted when the corresponding tooth is exfoliated.

Premature Loss of Deciduous Teeth

Deciduous teeth are often lost prematurely because of infection, trauma or accelerated resorption of unknown cause. The eruption of the first permanent molar distal to the deciduous dentition and before exfoliation of the deciduous molars predetermines the space available for eruption of those permanent teeth which must eventually replace the deciduous teeth. A comparative measurement of the total space occupied by the deciduous teeth and that needed by the succeeding permanent teeth indicates a slight leeway of one or 2 mm. in each quadrant. This permits the slight freedom of movement needed by the

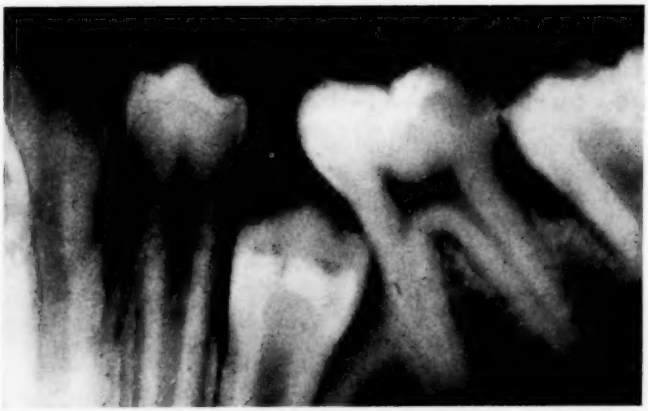

Fig. 16. A premature loss of the second deciduous molar permitted tipping of the first permanent molar into space to be occupied by the blocked premolar.

permanent teeth to maneuver into their proper position. Tight contact is finally achieved by the ever-present tendency of the first permanent molar to seek a more mesial position. It is this forward drift that creates a problem after the premature loss of a deciduous tooth. Thus the first permanent molar is the key to alignment of the permanent dentition. Inasmuch as the eruption of the first permanent molar precedes eruption of the bicuspids by four or five years, premature loss of the deciduous molars permits the first permanent molar to drift mesially into the space formerly occupied by the second deciduous molar, thus locking out the bicuspids, as illustrated in Figure 16. Furthermore, the tooth which formerly occluded with the prematurely lost deciduous tooth will extrude. This step effect of the occlusal surface causes occlusal interferences resulting in stresses which predispose to periodontal disease. Thus, for the want of one deciduous molar, the child becomes a dental cripple!

Preservation of the space occupied by prematurely lost deciduous teeth is termed *space maintenance* and is achieved by various types of intraoral appliances. Intervention is not always necessary. Periodic measurements of the available space compared with the space needed determine the most opportune time to initiate treatment. A space maintainer is usually indicated if a deciduous molar is lost a year or two before its average exfoliation time.

Some areas are affected less critically than others by the early loss of deciduous teeth. Generally, the need for intervention decreases as the region of premature loss approaches the anterior teeth. Space maintenance is uncommon in anterior regions because of a tendency toward arch expansion in this area during the transitional growth period.

Eruption of the Permanent Teeth

Permanent teeth may erupt before exfoliation of the deciduous predecessors, particularly the permanent lower incisors, as illustrated in

Fig. 17. The permanent incisors erupted in a position lingual to the unexfoliated deciduous incisors. Growth has provided space to accommodate the permanent incisors.

Figure 17. Too early extraction of the deciduous incisors may nullify the growth stimulus in this region effected by pressures of the erupting permanent incisors. The deciduous incisors are extracted if space is available for the permanent incisors and conditions for exfoliation of the deciduous incisors are favorable. Too early or multiple extractions permit collapse of the arches.

Crowded Anteriors

Crowding of the lower permanent incisors may occur before lower deciduous molars are exfoliated. If archwise measurement of the space between the first permanent molars indicates that sufficient space is available for all permanent teeth, intermittent serial extractions of the

deciduous cuspids and molars will permit alignment of the crowded incisors, in which case a guiding appliance is indicated.

Delayed eruption of the permanent teeth suggests insufficient growth of the root, impaction of the tooth due to insufficient space, cyst formation, or ectopic eruption when the erupting tooth is obstructed by the curvature of the adjacent crown. In these instances the indicated *treatment* may be space regainment, removal of overlying tissue, or disengagement. An erupting tooth usually follows the path of least resistance.

Ankylosis may be reason for tardy eruption. Extraction is the final resort if exposure of the occlusion surface does not stimulate eruption. Orthodontic movement of an ankylosed tooth is seldom successful.

Supernumerary Teeth and Missing Teeth

Hereditarily or congenitally missing permanent teeth cause an unbalanced occlusion and asymmetry of the dentition, and predispose to

Fig. 18. A supernumerary tooth in the left central incisor position caused by premature exfoliation of the deciduous incisor and prevents eruption of the permanent incisor. Extraction of the supernumerary tooth is indicated.

dental caries and periodontal disease. Allowances can be made for the missing tooth by preserving the space until conditions for a prosthetic replacement are propitious; or the remaining teeth can be guided during the eruption period in such a manner as to preserve arch continuity and occlusal balance. Bilaterally missing upper second incisors are often replaced by the cuspids with a corresponding mesial shift of the posterior teeth. In this instance the cuspid is reshaped to simulate a second incisor.

A supernumerary tooth of the deciduous dentition is unusual and of

little consequence because the extra space can be used in accommodating the permanent teeth. Delayed eruption of permanent teeth is often caused by supernumerary teeth. Such teeth should be removed whether erupted or not; otherwise they cause resorption of the adjacent teeth, become cystic or cause an occlusal deformity. Figure 18 illustrates premature exfoliation of upper deciduous incisors and interference with eruption of the permanent incisors caused by a supernumerary tooth.

Diastemas

Labial frenums which attach on the crest of the alveolus are not removed until it is evident that the erupting incisors and cuspids will not close the space by their own eruption pressures. Too early interference disturbs the arch growth stimulus in this region, causing crowding of anterior teeth. Should intervention finally be necessary, a wedge of tissue is removed and the teeth approximated by an appliance. Premature surgery only forms scar tissue, which is a further obstacle to eventual closure.

Tooth Versions

Individually locked teeth, when an upper tooth erupts lingual to a lower tooth, can be guided into proper position by simple pressures, provided there is room for the tooth in the normal arch alignment. The farther the offending tooth erupts into the undesirable position,

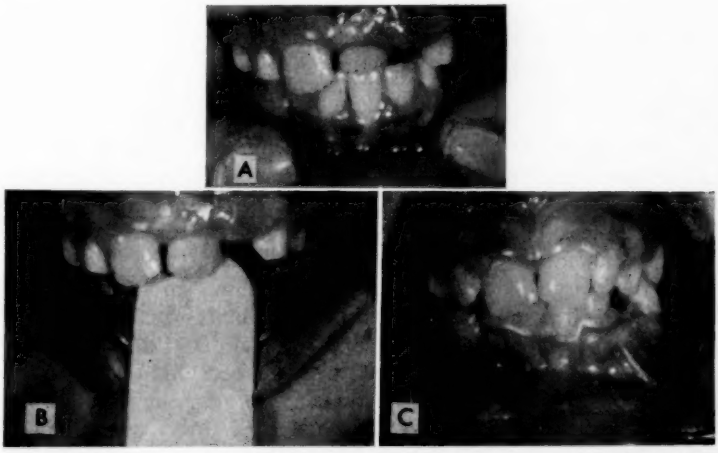

Fig. 19. This sequence illustrates the "jumping" of a left permanent central incisor from lingual version to normal position, using a tongue depressor blade.

the more difficult is its correction. A locked tooth can be "jumped" with the aid of a tongue depressor if the overlap is slight, as illustrated in Figure 19. Severe overlaps require sustained pressures provided by inclined plane appliances.

Harmful Oral Habits

Oral habits are capable of influencing the growth pattern by the application of slight but effective pressures on the oral tissues. It is evident that pernicious oral habits are capable of producing deformities, whose severity varies with the region, pressure applied, duration of the habit activity and intermittent recovery period. Agreement as to how and when the habit should be corrected, if at all, is not so evident.

Underlying emotional disturbances are responsible for the initiation of some physical activities which develop into habit patterns. Removal of the underlying cause usually reveals persistence of the habit. Children with this type of habit etiology require study by a child psychiatrist. Rejection, insecurity and unfavorable social environment are underlying factors. Undesirable habits can be corrected for some children without psychiatric consultation with the possibility that the emotional disturbance will manifest itself in another manner, perhaps worse.

Habits which do not stem from a serious emotional disturbance or which have persisted after removal of underlying causes respond to *psychological treatment*. The child is instilled with a strong desire to eliminate the habit. Any assistance, either verbal or mechanical, is only to remind the child of this desire. Complete understanding and acceptance by the child of the proposal are prerequisites to this form of treatment. The use of corrective aids prior to the age of reasonability is not recommended without consultation with a child counselor. Determination of the cause and effect of the oral habit and the necessary corrective measures is a responsibility shared by the dentist, orthodontist, pediatrician and child psychiatrist. There is no question that pernicious oral habit, if untreated, can permanently deform facial structures, particularly during the period of growth and development. The deformity caused by finger sucking and deformity sustained by a tongue habit after habit correction are illustrated in Figure 20.

It is not easy to detect conditions predisposing to habit patterns. However, the history may disclose some contributory factors. Inactivity or inhibition of motion of the infant thwarts attempts at hand coordination. If this activity is hampered by tight bedclothing or personal clothing, or if there is nothing for the child to grasp, he may resort to some activity, possibly thumb or finger sucking. Under sustaining conditions this may develop into a noxious habit.

Nutritional disturbances may influence the infant's sleeping habits.

The mother may encourage sleeping on the stomach to relieve the discomfort. This exerts pressure on the developing facial structures and is accented by sleeping on the hand or arms. The forward thrust of the mandible is a manifestation of a nutritional disturbance, obstruction or constriction of the airway, and may develop into a habit.

The pediatrician has the advantage over the dentist in the prevention of habit patterns because the pediatrician usually sees the child early enough to become acquainted with predisposing factors. The correction

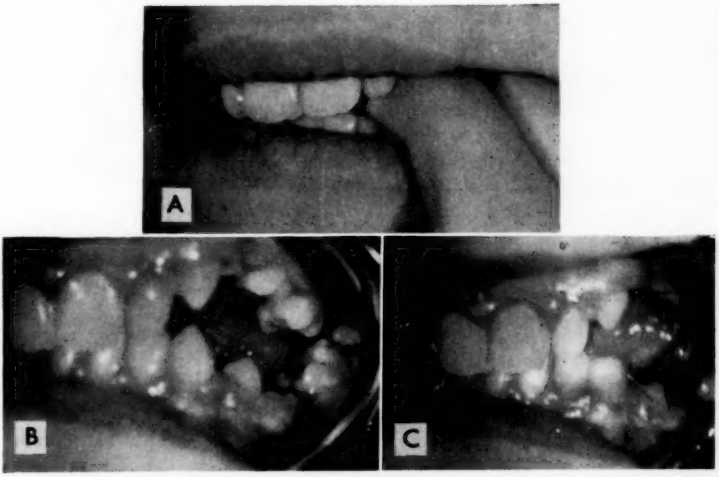

Fig. 20. The oral deformity of a 14 year old boy caused by a finger-sucking habit. The substitution of a tongue-thrust habit for the "corrected" finger habit sustains the deformity.

of harmful oral habits becomes a treatment responsibility of the dentist usually after the habit has become an integral part of the child's life. The parent should be advised relative to (1) the sleeping position of the infant, (2) a compatible diet, (3) appropriate activities corresponding to aptitude, and (4) signs of emotional disturbances.

Growth and development problems of the deciduous and permanent dentitions are varied and endless. A few of the most common preventive orthodontic procedures have been presented. Early recognition, timely intervention and frequent follow-up are the watchwords in prevention of malocclusion.

CHILD MANAGEMENT PROBLEMS

Although not an oral handicap, a child management problem is a definite handicap in children's dentistry. The stress placed on child

management is without reason when compared to the frequency of its occurrence in an efficient dental office where the personnel is familiar with the mannerisms of children. However, it is worth mentioning because previous medical or dental experiences of children are frequently the underlying cause of a behavior problem. Most child management problems can be averted if handled properly, in spite of inadequate parental control.

Parents are becoming more aware of the need for dental treatment for the preschool child. More children are seen in the dental office between the time of completion of the deciduous dentition and three years of age, but the number is still far from desirable, even among families who should know better. It is far easier to maintain a child's oral health than it is to re-establish it after neglect. It is impossible to perform the meticulous operations of dentistry for the unruly child, whereas the medical treatment can usually be achieved in spite of the child's attitude toward the treatment.

A visit of the child to the dental office before an oral condition demands attention generally prevents a management problem later. For the initial dental experience, dentists prefer the two and a half to three year old child who does not need dental treatment rather than the school-age child who is there for pain relief. Furthermore, the older child has been exposed to the torments of playmates and is negatively conditioned by the parent who claims "it won't hurt."

Dental office visits at an early age of the dentally well child not only permit the introduction of preventive procedures at the most opportune time, but also prevent the development of child management problems. The dentist and the preschool child are relying on the pediatrician to give the child the proper start toward oral health.

A briefing of the parents concerning conduct toward the dental visit promotes a more pleasant experience for the child and the dentist. A *laissez faire* attitude by the parent toward the proposed visit is commendable. Particularly, the child should not be conditioned by expectations. The parents should let the dentist manage the child and expect the child to enter the treatment room alone. The child's dental appointment should never be sandwiched between the parent's appointment and that of the next patient.

ORAL MANIFESTATIONS OF NUTRITIONAL DEFICIENCIES

Nutrition of the child during formation and growth of oral structures is particularly significant when considering the calcified tissues of the teeth. The tooth development period provides the only opportunity to contribute to formation of sound tooth structure through nutrition. Tooth formation, in contrast to other oral tissues, is an irreversible

process; that is, once formed, normal systemic and local metabolic processes are not known to cause a demineralization or remineralization of previously calcified tooth structure. Thus teeth are a permanent record of the nutritional conditions that prevailed during their development.

The strength and resistance of the tooth depend on the calcium and phosphorus intake of the child during the tooth development period. Vitamins A, C and D, and calcium and fluorides are particularly essential for the development of sound enamel and dentin. Once the tooth is formed, nutritional alterations are a manifestation of local dietary effects. Fluoride in municipal water supplies in optimum quantities, approximately one part of fluoride per million parts (ppm) of water, is classified as a nutrient and is an essential element in the development of caries-resistant teeth.

Inasmuch as embryonic dental tissues begin differentiation early in fetal life and the effects of nutrition during this period are relatively permanent, it becomes evident that adequate maternal nutrition is of great consequence to the future dental health of the child. If the mother decides to nurse the infant, then nutrition during the lactation period is of continued importance. Good prenatal care and infant feeding are associated with a reduction in caries susceptibility.[23]

The teeth begin development about the middle of the second month of gestation. By birth, the crowns of the deciduous incisors are completed, as are most of the deciduous cuspid and molar crowns. All the permanent teeth with the exception of the second and third molars are in some form of development. Some nutrients essential to tooth formation, such as calcium and phosphorus, are stored by the mother and are available to the fetus regardless of maternal nutrition, even at the expense of the mother's skeletal reserves. Other nutrients, such as vitamin D, are not stored by the mother, and the effects of a deficiency of these in the maternal diet are manifested permanently in the quality of the tooth structure concurrently formed. Nutritional guidance after birth and before eruption of the deciduous dentition, relative to the formation of resistant teeth, is assumed by the pediatrician. Seldom is the dentist consulted on matters pertaining to nutrition during the tooth formation period.

Calcification of the permanent teeth begins at birth, and portions of the deciduous teeth are still calcifying up to three years of age. Hence the obstetrician and the pediatrician have an excellent opportunity through nutrition to contribute a lasting quality to dental health.

Aside from the teeth, adequate nutrition is a valuable preventive measure in sustaining the health and resistance to disease of the tongue, lips, gingiva, alveolar bone, periodontal membrane, and so on, through systemic and local metabolic activity. Vitamins A, B and C are essential

if oral soft tissue manifestations of nutritional deficiencies are to be prevented, while sound alveolar bone requires adequate mineral intake supplemented by vitamin D.

The physical character of food is a significant factor in maintenance of oral health. Coarse, nonadhesive foods tend to cleanse the accessible surfaces of the teeth and soft tissues as well as exercise a massaging effect on the oral mucosal tissues.

Manifestations of nutritional deficiencies frequently are detected first in the oral tissues. Early recognition of oral manifestations and prompt correction of the diet can prevent severe or permanent damage to tissues elsewhere in the body.

DENTAL CARIES

Etiology

Present concepts of dental caries indicate that bacteria in close contact with the tooth surfaces obtain their nourishment from foodstuffs dissolved or suspended in the saliva. This process, achieved by means of enzyme systems, results in the growth and multiplication of bacteria and in a variety of end-products. The latter substances, and perhaps the enzymes, affect the tooth surfaces intermittently, for varying time periods, depending on the availability of foodstuffs.[26] Dental decay cannot occur in the absence of oral bacteria or the nutrients necessary for their life processes. The prevention and/or control of dental caries is achieved by increasing the resistance of the enamel and dentin to the disintegrative mechanism and/or by reducing the intensity of the disintegrative mechanism. Such measures are designed to prevent the appearance of new lesions. If not completely effective, it is possible that their use might retard, at least, the initiation of new lesions and the progress of existing lesions.

Operative Procedures

Cavities and deposits around the teeth, in themselves, permit the growth of bacteria and support caries activity. Thorough oral prophylaxis and filling of all cavities afford the best protection to the dental pulp in a limited time as well as reduce the intensity of present caries activity.

Certain fundamental principles of cavity preparation and restorative design are carried out to assure the future protection of the tooth and permanence of the restoration. These include extension of the cavity margins onto self-cleansing areas, the inclusion of adjacent defects, and the proper contouring and finishing of restorations. Adherence to these

principles minimizes decay occurring on an adjacent tooth or about the margins of restorations on the same tooth.

The chances are over 2500 to 1 that caries will develop in the pit or fissure of a tooth.[7] The elimination of a noncarious but susceptible pit or fissure by modified restorative procedures (prophylactic odontotomy) in a mouth with marked caries activity offers several advantages: (1) Considering the odds that a cavity will develop in the defect, a prophylactic odontomy permits a cavity depth and outline controlled by the dentist, not by the extent of the carious lesion present. (2) Limiting the preparation to the enamel when removing an enamel defect is well received by the child patient, while a larger lesion would necessitate painful involvement of the dentin at a later date. (3) One is not sure whether the patient will be seen by the dentist before a carious lesion becomes so extensive as to necessitate loss of the tooth.

Fluoridation

Dentistry has relatively few specific preventive procedures as compared with medicine. Fluoridation of the water supply and the topical application of sodium fluoride solutions are two procedures in dentistry whose primary objective is prevention. It is well established that the natural occurrence of fluorides in community water supplies is responsible for the low incidence of dental caries in the respective communities.[2] Recently completed 12 year controlled studies have demonstrated that children six to eight years old who were exposed to artificially fluoridated water during both the prenatal and postnatal growth periods have experienced up to a 65 per cent reduction in dental caries.[6] In spite of the vast and rapidly accumulating evidence supporting fluoridation, opponents continue to criticize this most effective public health measure.

The safety and effectiveness of fluoridation have been thoroughly investigated and have received the support of leading health authorities and societies. The pediatricians of Evanston, Illinois, detected no physical changes between their young patients of Evanston receiving fluoridated water and those from nearby communities where the water is free of fluorides.[6] Investigations show no significant differences in occurrence or degree of gingivitis, calculus, pulp nodules, cysts and alveolar bone resorption between the inhabitants of two cities in Texas, one with 8.0 ppm concentration of fluorides and the other with 0.4 ppm.[27] As of the first of December, 1956, 1437 communities have fluoridated their water supplies serving 30,532,670 people.[4] In the Newburg-Kingston 10 year study, in which the water supply to Newburg was fluoridated at a level of 1.2 ppm, no difference of medical significance could be found between the children drinking the fluoride-

free water of Kingston and those of Newburg.[21] In the tenth year of a similar study, the Grand Rapids-Muskegon Fluoridation Study, a 54 per cent reduction of dental caries in deciduous teeth of six year old children was observed.[20] This age is usually a peak in caries prevalence. In the permanent teeth the reduction averaged about 60 per cent. There was approximately a 25 per cent reduction among those whose teeth had already calcified or erupted when the program was initiated.

Still, there are communities which have rejected or discontinued fluoridation for various unfounded reasons, usually at the instigation of radical minority groups who, by loud and deceptive propaganda methods, have duped the public. The acceptance of a fluoridation program depends on the successful education of the public on an individual basis. Many questions concerning its effectiveness and safety are asked by parents of children under pediatric care. The pediatrician can immeasurably assist the dental profession by presenting an unprejudiced evaluation of the facts.

Topical Fluorides. Whereas fluoridation of the municipal water supply is a public health measure, the topical application of a 2 per cent solution of sodium fluoride is a dentist-patient procedure. Cavities continue to be detected after topical fluoride treatments, since the maximum effectiveness is about 40 per cent reduction in dental caries.[12] Fewer cavities are detected in a given time because they develop at a slower rate. If this retarded rate can be maintained until the child reaches the age of relatively low caries susceptibility, then the reduction may become permanent. Parents are cautioned that topical fluoridation is not a panacea; the treatment only results in a 40 per cent reduction over what might have been detected in the same time interval.

A series of four applications of a 2 per cent solution is applied to all erupted teeth at age levels corresponding to the eruption pattern of groups of teeth, usually about three, seven, 10 and 13 years of age. Thus four series are given, totaling 16 applications. Although there is no apparent limit on the permanency of the protection of a series of applications, the series is given at various age levels in order that newly erupted teeth may receive the benefits without waiting until the eruption of all teeth is completed.

A series of applications at three years of age is particularly advantageous because it introduces dentistry to children as a pleasant experience. The first application is preceded by an oral prophylaxis, which likewise is a pleasant patient-dentist relationship.

It may still be necessary to apply sodium fluoride topically where water supplies are artificially fluoridated in order to protect the enamel of teeth which were formed prior to the initiation of the municipal program.

Evidence of the success of other impregnating chemicals to increase

the resistance of enamel to dental caries does not warrant their use at this time.

Dietary Procedures

An obvious method of reducing the intensity of the disintegrating mechanism of the dental caries process is the elimination of the source of the deleterious end-products. That the diet has a direct and local relation to the incidence of dental caries is evidenced by the absence of dental caries in the mouth of rats which were fed a cariogenic diet through stomach tubes.[11] Cariogenic diets fed to germ-free animals by normal ingestion did not produce dental caries, while bacteria-inoculated animals fed the same diet developed dental caries.[18] These studies would indicate that dental caries is local phenomenon dependent upon the presence of bacteria and a suitable substrate. The elimination of either factor from the oral cavity has resulted in a complete inhibition of dental caries. Research is being conducted on germ-free animals in an attempt to isolate the specific bacterium or bacteria involved.

Inasmuch as bacterial prevention of dental caries is not possible or practical at this time, clinical efforts are concentrated on elimination of the easily fermentable carbohydrate, primarily in the form of sugar. This reduces the quantity and intensity of acid produced in the dental plaque; by eliminating the source of the metabolic requirements of the bacteria associated with dental caries, their numbers are reduced.[9] In a 50 year study of the prevalence of dental caries of 800,000 European children, a direct correlation was noted at the beginning of both World Wars between the consumption of refined sugar and the incidence of dental caries.[24] There is evidence that some people have a low caries attack rate in spite of a diet high in starch content, provided the intake of refined sugar is low.[22]

For the reasons cited, it is obvious that sugars in the diet should be restricted. It is estimated that the average person consumes 140 pounds of sugar per year.[10] Yet this person needs to consume only 25 to 40 pounds of sugar per year, depending on age and activity, in order to satisfy his caloric requirement.[16] Thus more than 100 pounds of sugar per year is consumed in excess by the individual. A considerable reduction of this excessive sugar consumption can be achieved by eliminating confections, pastries and sweetened beverages from the diet without impairing its nutritional value. At the same time the diet of the child is improved because (1) more nutritious foods are substituted for foods high in refined sugar content, (2) the appetite of the child is not curbed by sweets, and (3) essential vitamins are not drained off to metabolize the excess sugar.

It is disconcerting to find members of the medical profession scoffing

at the dentists' attitude toward sugar reduction. Hard candy and chewing gum sustain conditions favorable to a continuous, prolonged, intense caries attack on the tooth of the susceptible child as long as the confection lasts. If sweets must be consumed, the least time spent in the mouth the better, thus reducing the duration of attack. The "rewarding" of good behavior by candy bribes contributes to poor oral health and to the establishment of unacceptable oral health habits.

Animal and human experimentation has demonstrated that dental caries can be prevented almost completely by elimination of sugar from the diet.[17] Although there is convincing validity for the effectiveness of this form of caries control in children, the fact that it requires the complete cooperation of the child, parents, relatives and physicians has prevented its achievement with much success.

The decalcification of the inorganic structure of enamel and dentin consists of a series of intermittent attacks, occurring when suitable substrate is available.[25] By reducing the frequency of sugar ingestion, the number of attacks is diminished and the total caries activity is reduced. Hence the child should not only strive to eliminate all foods containing refined sugar, but should also make a particular effort to remove them from the in-between-meal and bed-time snacks.

Oral Hygiene Procedures

From the preceding, it follows that the more rapidly the substrate is removed from the mouth, the less will be available for bacteria growth and activity. It is imperative that the food substrate be removed immediately after eating by brushing the teeth or, if this is not feasible, by forcefully rinsing the mouth with water.[13]

Complete clinical evidence is lacking relative to the efficacy of therapeutic dentifrices. Announcements from the American Dental Association should be consulted concerning the effectiveness of recently developed dentifrices and patients should be advised accordingly.

Introduction of the child to the toothbrush is mostly a matter of imitation of the parent. Thus habits of oral hygiene of the child are usually those of the parent. Advising the parent to adopt an acceptable toothbrushing technique not only in the mornings, but also after every meal, will start the child on good oral hygiene habits. The toothbrush technique to be used is one which not only cleans the teeth of the mucin film and all food particles accumulated during the meal, but massages and stimulates the gingival tissues as well.

ORAL INFECTIONS

Dental Infection

Never is an infected, untreated deciduous tooth retained in order to preserve the space until the normal exfoliation time. Suppurative in-

fection is not tolerated in any part of the body, and the mouth is no exception. Fortunately, in one sense, caries of deciduous teeth will progress through the various stages of infection without pain until a fistula or "gum boil" develops. Such fistulas are usually detected on the buccal alveolar mucosa. Immediate attention is warranted to prevent infiltration of the adjacent bone or penetration of the maxillary sinus, facial tissues or glands. The follicles of unerupted teeth are favorable to the development of osteomyelitis because the infection is inaccessible to local treatment.[1] Not only is the infected tooth a drain on body resistance and a source of systemic bacterial infection, but also the broken down teeth and snags inhibit proper mastication of foods, thereby preventing proper digestion.

Cysts initiated by infected primary teeth and which involve the developing permanent teeth are not uncommon and should receive immediate attention lest their growth result in pathological fracture or permanent disfigurement.

Pulp Infections

Pulp involvements of deciduous teeth caused by dental caries or trauma are treated according to the severity of the infection. By early treatment it is hoped to prevent loss of the tooth and the related sequelae, such as reserving space for eruption of the permanent tooth, providing function and maintaining good esthetic and speech qualities. A favorable history and clinical findings may indicate treatment of minute exposure of the pulp (*pulp cap*) or removal of the coronal portion of the pulp (*pulpotomy*). Complete pulp removal (*pulpectomy*) is uncommon in deciduous teeth because of possible injury to the developing permanent tooth and because the numerous accessory pulp foramina of deciduous teeth prevent an adequate seal of the pulp canal.

Soft Tissue Infections

Gingivitis and periodontal disease are less common in the mouths of children than of adults. *Gingivitis* in the very young is usually of a systemic background. Nutritional deficiencies, acute infectious diseases, toxic chemicals and blood dyscrasias are a few of the more general underlying causes. A thorough examination of the mouth may reveal the first clinical indications of such systemic diseases, deficiencies or dysfunctions as scurvy, diabetes, leukemias, Dilantin hyperplasia, the childhood exanthemas, neoplasms, and many others too numerous to mention. Vincent's infection, herpetic stomatitis, thrush, black hairy tongue, geographic tongue and others are oral diseases of children.

Vincent's organisms frequently are secondary invaders of most oral disturbances and can be isolated from healthy mouths. One should rule out other possibilities before hastily diagnosing any oral soft tissue disturbance as *Vincent's disease.*

Although *periodontitis* is uncommon in the child, the conditions for its development in adult life are frequently formulated during childhood. Such factors as malocclusion, poor contacts between teeth, inadequate tooth contours, untreated carious lesions, food impaction, oral traumatic habits, bruxism, improper or lack of oral hygiene, and others, if permitted to persist, may ultimately cause an irreparable periodontal condition.

TRAUMATIC INJURIES TO THE TEETH

Traumatic injuries to the mouths of children frequently end in the pediatrician's office. Most require immediate x-ray examination, diagnosis and treatment by a qualified dentist. Twenty-four hours may mean the difference between a favorable or unfavorable prognosis. Certainly the pediatrician should initiate whatever emergency treatment he deems necessary to alleviate pain, hemorrhage or shock. Aside from this, any further delay of the child in reaching the dental office jeopardizes the prognosis of conservative treatment.

Traumatic Injuries of the Deciduous Teeth

Most traumatic injuries to deciduous teeth result in their displacement into the tissue or complete removal from tissue support. In displacement, if the crown of the tooth is exposed, it may be realigned by gentle pressure. If completely embedded in the alveolar tissue, the teeth usually re-erupt, provided there is no evidence of tooth or alveolar fractures, foreign objects or extremely poor alignment of the displaced teeth. Unlike the permanent teeth, a temporary loss of vitality may result, or even a darkening of the teeth. However, these teeth have been known to recover. The tooth is left alone as long as there is no evidence of infection, by either x-ray or clinical examination. A close observation is kept of its resorption progress as normal exfoliation time approaches. Nonvital teeth do not always resorb at the normal rate, if at all.

Loss of deciduous incisors at age three is not only a local disfigurement and loss of function, but a psychologic trauma as well. Children are psychologically prepared to accept the normal exfoliation of teeth when the time arrives, but premature loss of anterior teeth, attended by the torments of playmates, may produce emotional disturbances or patterns difficult to correct.

Traumatic Injuries to the Permanent Teeth

A blow on a permanent tooth, on the other hand, is more likely to result in a fracture of the crown or root. The fragment of the fractured incisor illustrated in Figure 21 is embedded in the lower lip. Here, time is of the essence. Treatment of young permanent teeth is complicated by incomplete root calcification. Therefore conservative treatment of the pulp is most desirable. The sooner these injuries are seen by a dentist, the better are the chances for conservative treatment.

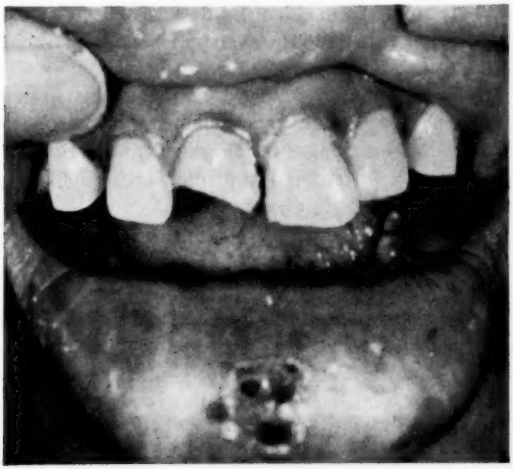

Fig. 21. The fragment of the fractured right central incisor is embedded in the lower lip. All soft tissue wounds accompanying traumatic injuries to the teeth should be examined roentgenographically.

The fracture of a permanent incisor is a serious tragedy in the life of the child and parent; the scars of it are not completely eradicated until the child reaches 16 to 18 years of age. It is unusual to lose the tooth unless the root is fractured near the crown.

EARLY LOSS OF MULTIPLE TEETH

The loss of multiple teeth in the child creates many problems which, if not corrected, may persist to some degree throughout adult life. Some of the changes which develop in such untreated cases are inability to masticate food, formation of noxious habits, speech impediments, alterations in growth and development and the psychologic trauma accompanying these changes. Replacement of the missing teeth restores function and prevents factors contributing to malocclusion, abnormal tongue and lip habits, inferiority complex patterns, improper food selec-

tion, speech impediments, atrophy and deformity. Replacements for anterior teeth are relatively uncommon unless esthetics is an important consideration or the missing anterior teeth are included on a denture where replacement of the posterior teeth is the primary objective.

Partial dentures replace missing teeth lost through infection, trauma or congenital malformations. It is surprising how well these dentures are tolerated by children. In most instances they are proud of their new possessions. The child accepts a partial denture without difficulty provided he has reached the physiologic and mental age of two and a half.[3]

Allowances are made in the denture design to accommodate changes in growth and development if the denture is indicated at an early age. Clasps for retention of the denture are generally avoided during the period of eruption of the permanent incisors and first molars.

A complete study of the child's physiologic and chronologic oral development as well as his mental development and attitude is necessary. It is usually necessary to redesign and remake the denture a few times in order to provide for growth changes.

SUMMARY

Like the pediatrician, dentistry recognizes that prevention begins with the child. In fact, prevention is of great significance to the dental profession because of the prevalence and characteristics of chronic dental diseases, the vast backlog of accumulated dental needs and the diminishing dentist-population ratio.

The oral cavity is a sensitive reflector of the general health status of the patient. The first indications of such systemic disturbances as blood dyscrasias, nutritional deficiencies and endocrine dysfunctions are frequently observed as oral tissue changes. On the other hand, there are diseases, dysfunctions, dystrophies and disorders specific to the oral environment which affect the general health of the child. Therefore the prevention, early recognition and treatment of oral handicaps should receive attention by the pediatrician equal to that for other functions and structures of the child's body. All too frequently the mouth has only provided access for examination of the throat.

The initiation of preventive dental procedures during preschool ages has been a problem for the dental profession because of insufficient contact with the child or parent. On the other hand, the pediatrician has an opportunity to initiate the dentist-patient relationship at this most critical stage of oral development.

The oral handicaps discussed are by no means complete in number or content, but sufficient information is presented to acquaint the pediatrician with the most prevalent dental problems, to assist him in their recognition, and to suggest his contributions for their prevention and

treatment. Certain aspects of dental health are stressed in which the cooperation and participation of the pediatrician is particularly sought, not only materially, but also to give credence to certain dental procedures and recommendations.

The dental health of the child and adult depends to a large extent upon the dental consciousness of the pediatrician.

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SOCIAL AND EMOTIONAL HANDICAPS OF CHILDREN

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All children have some difficulty in growing up. This is inevitable and probably necessary if a child is to strengthen and develop his own capacity for meeting the problems of daily living. The fact that a child has some difficulty is not as important as the extent and the severity with which it interferes with his general adjustment. One evaluates problematic behavior in a child not by symptoms, but in relation to his total reaction to his life experience at that time. We are all familiar with the fact that the quiet, too good child may be more upset than the trouble maker. The latter usually forces us to pay some attention to him. It is well, too, to recognize that the child who responds to stress by physical rather than emotional or behavior symptoms is very likely having considerable difficulty in growing up.

Even under the best of circumstances, growing up is fairly complex and difficult. As one looks at the numerous and diverse forces which come to bear either directly or indirectly on children, it is amazing that they do not have more difficulty than they do. Reliable statistics on children for a real cross section of the population are not known. Scull,[12] however, in his report on the incidence of significant emotional problems in a survey of 755 "new" children in the pediatric out-patient department at Stanford, noted that 40 per cent of these children had "emotional problems to a degree that interfered with, or prevented institution of somatic therapeutic measures that might otherwise be successful." This is probably higher than is seen in the general run of children coming into a pediatrician's office. Out-patient departments in general have a considerable proportion of patients from families who have complicated social and emotional problems. These family complications have some influence in producing problems in children, although in some instances the emotional problems in the children stem

from the emotional maladjustment in the parents which has played a large role in bringing on the family's social and economic problem.

Complicated as the process of growing up is, it is possible for purposes of discussion to separate the three major factors which largely determine the personality development and adjustment of children. The first is the child's own innate make-up. This determines how he experiences and reacts to the stimulations and pressures of the world around him. The second major factor is parental influence, which has a powerful effect upon the way the individual child comes to terms with and uses his innate potential. The third factor is the influence of the particular culture or subculture of which the family is a part. This exerts its influence through the parents upon the child-training methods which are used and the general philosophy and attitudes which underlie these methods.

INDIVIDUAL DIFFERENCES

Everyone recognizes that people, including babies, are different one from another. The nature of this difference, particularly those elements which comprise it and the causes for it, is not as clear. We know something of what one may expect in individual differences in physical growth and development as well as something of the differences in basic intellectual capacity. Inner differences which determine the way a child experiences and reacts to his environment are harder to measure and understand. The work of Fries[5], though far from definitive, is of interest as one attempts to attack this problem. She made use of the differences in response to a deliberately provoked startle reaction and also made observations of the hungry infant's response to sudden interruption of an unfinished feeding. It was found that nontraumatized children of 10 days to two weeks of age could be divided on the basis of their responses into five groups. These consisted of quiet, moderately active, and active, with what may be pathological groups at either end of the scale consisting of children who were hypoactive and hyperactive. These congenital activity types are characteristic of the neonatal period. They become modified by experience into what is called activity pattern, which is a combination of the original congenital activity type with whatever modifying effects environmental circumstances have produced. In general, it may be said that favorable circumstances tend to make the extreme reactions less extreme, and unfavorable circumstances do the opposite.

The activity type not only has a considerable influence on the ways in which a child reacts to experience, but it also profoundly affects the way in which the environment and particularly the people in the environment react to the child. This is most clearly seen in the effect

that a hyperactive child can have on his parents. This is the child who wakes at the slightest noise, cries a great deal seemingly without cause, is easily upset by minor disturbances in his environment and often spits up when he cries. It is not hard to understand how such a child can try even the warmest and calmest of parents. Pediatric textbooks for years have given some recognition to such children under the title, "the hypertonic child." The causes for these activity types are not understood, although recently there is suggestive evidence that some of the hyperactive children have some "dysfunction of the diencephalon" which "exposes the cortex to unusually intense storms of stimuli from peripheral receptors."[10] It is believed that this condition usually corrects itself after a period of years. Some of these children seem to be specifically helped by the use of amphetamine.

PARENTS

Parents play a paramount role in the adjustment and in the personality development of their children. This is true for many reasons, but it is especially important in human development because of the long period of dependency which provides a continuity of meaningful relationships during the most impressionable years. Studies of early psychological development indicate that the infant initially has no awareness of himself as a separate person, but only as a part of a larger whole consisting of himself, his mother and his immediate environment. The first great psychological hurdle which the young child faces is the gradual awareness of himself as a separate person. A large part of the process of growing up consists in working out, with the understanding help of parents, what kind of separate and yet related person he can be. It is through the support of and in relation to his parents of both sexes that the child is able to accomplish this. He uses them both as models and as reflecting surfaces to test out his reactions and capabilities. Parents are often blamed for all the things their children do, particularly those things which are not socially approved. It cannot be denied that parental influence is the major force in determing the direction and character of the child's personality development, but one always needs to keep in mind that the make-up of the child not only contributes to the way he reacts to his parents and to the world, but also in some measure influences how parents and the world react to him.

CULTURE

Culture initially exerts its influence through parents and not directly. As Fromm[6] puts it, "As long as mankind has not attained a state of

organization in which the interests of the individual and that of society are identical, the aims of society have to be attained at a greater or less expense of the freedom and spontaneity of the individual. This aim is performed by the process of child training and education . . . The child does not meet society directly at first; it meets it through the medium of his parents, who in their character structure and methods of education represent the social structure, who are the psychological agent of society as it were." The aims and methods of child training, though colored by the familial experience and personality adjustment of the parents, are largely determined by the attitudes and aims of the particular society of which they are a part. For example, the methods and the age at which toilet training is instituted show more variation between different cultures than they do between average families in a given culture.

When attempting to understand the behavior of a particular child, one needs to think in terms of his innate make-up, the personality and adjustment of the parents and the customs and standards of the cultural or subcultural group to which the family belongs. In practice one generally pays more attention to the parental influences, because these are more obvious and sometimes more modifiable. There is also a more personal reason for this because almost all of us carry with us from our childhood some unresolved antagonism to our own parents. This tends to make us quick to blame other parents for their children's problems. We recognize individual differences in children, but we often overlook the role that this has played in determining the behavior of the child as well as how this has affected the parent-child relationship. Cultural factors, too, are usually overlooked except when we deal with an individual from some group which is markedly different from our own. On the whole we are not yet very much aware of the effect of our own culture on our own and our children's behavior. Nor are we aware of the inconsistencies in our culture which may play a significant role in the genesis of some forms of behavior such as juvenile delinquency. For example, the concept of equal opportunities for everyone may be in sharp contrast to the experience which is open to individuals in certain subcultural or ethnic groups.

STAGES OF DEVELOPMENT

As a child grows up there are certain age periods which have their own specific difficulties based upon the particular neurophysiological and psychological characteristics of that stage of development. One also needs to bear in mind that the parent-child relationship develops and changes with the changes and needs of the growing child.

Prenatal Period

We know little about how emotional reactions in the mother and their physiological constituents affect the child in utero. The work of Sontag[14] suggests that infants of mothers who are emotionally disturbed during pregnancy frequently exhibit evidences of an irritable and hyperactive autonomic nervous system. He observed such children to have disturbances in gastrointestinal motility, tone and function manifested by excessive regurgitation, colic and sometimes diarrhea. "In prenatal development of such a condition, prolonged nervous and emotional disturbances of the mother during the latter months of pregnancy seemed to be important."[14] Although as yet there is no general acceptance that the emotional reactions of the pregnant woman will have some direct effect upon the unborn infant, there is some evidence that the feelings and attitudes that the mother has during pregnancy about her unborn child and herself as a prospective mother, may considerably influence her in her feelings and attitudes towards the child after it is born. Senn found in interviews during the prenatal period that the pregnant woman is often as apprehensive about her role as a mother as she is about her ability to deliver a viable infant. Since then the techniques of prenatal interview have been described in some detail by Jackson.[8]

At present few pediatricians routinely see mothers before the baby is born; however, at a recent conference[11] three participating pediatricians mentioned that, whenever possible, they attempt to have at least one prenatal interview with parents. They have found it useful in establishing a doctor-patient relationship as well as in helping the parents to be relieved of any extra anxiety beyond that appropriate to an uncomplicated pregnancy.

Infancy

The period from birth to approximately 18 months of age has a certain psychological unity because it is the approximate period when an infant is completely dependent upon its mother. This is a period when the child moves from complete dependence and complete unawareness that there is any difference between himself and his mother to a beginning independence and some notion of the difference between "thee and me." His initial contact with the world outside his body is originally established through general contact of his body with people and objects, centering especially its perception and sensitivity in his mouth and lips. From this he moves to an ability to be meaningfully aware of the world around him by vision, hearing and specific areas of touch. If the contacts which he becomes aware of through his

various senses are reasonably pleasant, he becomes increasingly interested in and related to things outside himself, especially people.

This is the period when a child develops his basic, almost automatic way of relating to people. If this works out well, he develops a built-in sense of trust[3] in himself and in his relationship to others and the world around him. If the contacts are uniformly unpleasant or if he has an unduly sensitive receptor system, he may withdraw or he may develop feelings that he cannot trust himself or the world around him. If, for example, he has a great deal of gastrointestinal discomfort, he may focus his attention so largely within himself as seriously to interfere with the usual development of contacts with the outside. The particular kind of disturbance which the child manifests in his relationship to the world seems to be related not only to the kind and quality of stimulation which he receives, but also to the way his innate make-up determines how he responds to it.

An extreme example of a combination of experience and inner make-up may well be early infantile autism.[9] This represents an extreme degree of withdrawal based in some instances on a lack of warm, affectionate stimuli, but probably more commonly due to an innate make-up which in some fashion makes inner experience infinitely preferable to outside contact. Because of their lack of connection with the world around them these children are usually thought to be feebleminded or to have a severe hearing impairment. At four or five months of age they do not respond with anticipatory pleasure to the prospect of being picked up by the mother. Language is slow to develop and is usually not used to convey meaning to others. Instead of answering they often repeat what is said to them. They relate better to toys and objects than to people. These children are now considered to have a form of early childhood schizophrenia.

In the last few years a great deal of time and thought has been devoted by child psychiatrists to attempting to understand and treat these children. It is clear that they are not mentally retarded, but it is also clear that exceedingly intensive and skilled psychiatric treatment is essential, and this for long periods of time if any therapeutic results are to be obtained. Differential diagnosis is often difficult, and one may need a period of observation by an experienced person before one can be sure. Unfortunately this has become a somewhat popular diagnosis to make, and it is often mistakenly applied to children who are merely quiet and shy as well as to children who are genuinely retarded.

The child who suffers from a chronic lack of warm, affectionate stimulation in the first year of life has been most clearly described by Spitz[15] and Goldfarb.[7] Subsequently Bowlby[1] summarized all the evidence available up to 1951 of the effects on infants deprived of what is considered to be a normal, warm, maternal relationship. Current

evidence seems to indicate that for reasons which we do not understand, not all infants under a year of age deprived of this relationship develop the profoundly depressed condition which in some becomes permanent mental retardation. Although there seems to be considerably more reversibility to the process than Spitz originally described, there are still severe effects on personality development, particularly in the area of the ability to form satisfactory interpersonal relationships. In a more recent report Bowlby[2] suggests that a lack of satisfactory emotional relationships in the early years of life may be one of the causes of the egocentric, conscience-less persons known as psychopathic personalities.

All this emphasizes that it is important for children during the first 18 months of life to have warm, sustained and dependable emotional relationships with the mother or an adequate mother substitute if there is to be a solid foundation laid for good emotional relationships with other people throughout life. There is also some evidence which strongly suggests that functional disturbances of the gastrointestinal tract, particularly the upper portion of it, have their origin in connections which are established between emotional reactions and gastrointestinal functions during these early months. This is a period when the body responds to emotional reactions almost entirely with physiological responses rather than with the outward signs of emotion characteristic of later life.

The Run-About Child

The second great period of development runs from approximately 18 months of age to some time between three and three and a half years. This is the period characterized by the child's developing skill in the use of his neuromuscular system so that he is able to be physically autonomous. He develops skills in being able to control and direct what he will do with his arms and legs, with his sphincters, as well as the muscular and respiratory coordination necessary for speech and verbal communication. Concomitant with this is his increased intellectual capacity and his progressive ability to manage a wider social and geographical arc. Psychologically, this is the period during which his beginning awareness of himself as a separate person is consolidated into a comfortable acceptance of himself as an individual different from but related to other individuals. If this individuation is successfully accomplished, it includes his acceptance of himself in whatever biological role he is cast in.

One of the most obvious signs of difference which needs to be accepted is the physical difference between boys and girls. In some children all the anxiety which they feel about separating from their

parents and accepting their new-found separate selves becomes focused on their physical difference. The very obviousness of the penis in the boy and the lack of it in the girl is a convenient and concrete difference upon which their feelings of goodness or badness, acceptability or nonacceptability can be hung. In other children the anxiety may be more specifically centered around physical separation from the parents which they attempt to avoid by all kinds of controlling behavior.

Many of the problems of this age stem from the pressure which comes to bear on a child if he does not conform to various social and cultural standards. This includes toilet training and his interest and attitude towards his genitals as well as his general curiosity and physical activity. It is because of this that toilet training and parental attitudes toward the natural genital interest of children of this age period have been given so much prominence. Toilet training is important, but not primarily because it is toilet training. It is important because it is a point around which a great deal of social pressure is exerted on a child to make him conform in certain culturally acceptable ways. The great difficulty which comes out of this is that the child does not view himself as acceptable or nonacceptable in terms of his total self, but in terms of the way in which he conforms in this limited area of his total functioning. In other words, he is good or bad, acceptable or nonacceptable as a total person largely around the way in which he handles his bladder and bowel function. This gives to a child a distorted view of his own value as a person and may permanently color the way in which he reacts because of the bizarre way, by adult standards, in which he thinks at this stage of bladder and bowel functioning and his own excretory products.

There is a healthy tendency in most children to rebel against these unreasonable pressures, and this sets the stage for a struggle between child and parents not only in this area, but also in every subsequent area, however reasonable, where the parent or other adult seeks to direct or educate the child. He becomes so conditioned against pressure that he has to fight against all pressures, even those which would help him. Unfortunately, he pays for this by guilt and uncertainty which the conflict with his parents produces. This does not mean that limits cannot and should not be set by parents, but it does mean that one should guard against being caught in a continuous will struggle with a child. One should frequently ask oneself, when there is insistence upon conformity in certain situations, whether one is really being reasonable and whether what one is doing does not represent a somewhat irrational need of our own to make the child give in. What may perhaps be an end result of this kind of struggle was recently described by a mother who said that she could understand how hard it was for her

small boy to give in because she had always felt that every time she gave in she was allowing herself to be completely destroyed.

Not all struggle between parent and child begins with toilet training. Some of it may have its origins earlier in feeding difficulties, particularly those which arise with the natural falling off of appetite at the beginning of the second year of life. Struggle once started tends to persist. If it lasts into the school years and beyond, it may interfere with learning, if not manifesting itself in much less subtle ways as openly defiant behavior.

This period between 18 months and three and a half years is a time of transition not unlike adolescence. It is a time when a child is passing from the dependency of infancy to the relative independence of the preschool child. This is a period when a child needs parents who are comfortable enough to set reasonable limits over his behavior and at the same time are able to support both his independence and his need at times to be less mature. This is the time when the child may have considerable difficulty in striking a balance between the big and little sides of himself. It is important that these limits, controls and directions be applied in such a way that the child does not feel that he is morally bad if he cannot immediately conform and does not completely agree. Hopefully he comes through these years with some acceptance of his difference from others as well as some feeling of his likeness; with the feeling that his body and its functions, of which he is just acquiring full awareness and control, are good and acceptable. It is not only with toilet training that struggles and baffled feelings arise. The tremendous physical energy of children at this age period with what at times seems to be almost a specific need for climbing, may in small apartment-dwelling children bring on as much struggling relationship between child and parents as do somewhat more specific areas of the function.

It is this period of life which best demonstrates the current confusion in thinking about the difference between setting healthy limits for children and genuine repressive measures. Fortunately we have pretty well worked through the wave of extreme permissiveness which either paralyzed parents or encouraged them to be irresponsible. Although this wave has considerably receded, there is now some evidence that the swing may go too far the other way. There is still a good deal of confusion in many parents' minds as to what limits their children need and what rights parents have to set them. Evidence of this confusion, as well as a denial of the difference between adult and child, is seen, among other places, where the parent encourages the child to call adults by their first names. Children need adults as parents; they need parents with the strength to stand for what they believe in, even though a child may need to test a parent out. The child is relieved when the parent does not give way before his pleas or pressures. With-

out this the child is left in the unenviable position of having to push out beyond the area he can comfortably manage in an attempt to find the limits of a situation. He is always overextended and knows it and yet feels impelled to keep pushing. He may be a controlling and an unpleasant child, but underneath he is also a frightened one.

Preschool Period

Chronologically, this period runs from approximately three and a half to five or six years of age. This is the time when the child begins to use his mind creatively and imaginatively. He is intrusively inquisitive, poking into everything that he encounters, trying to begin to fit himself into what it will be like eventually to be an adult. Having previously established that he is an individual, he now attempts to define more exactly what kind of individual he is and can be. This is done largely through a creative and active understanding of himself as a boy or a girl who can begin to get a little understanding of what these roles really mean biologically and socially. He explores and defines himself by exploring his relationship to each of his parents. If his relationship to both parents is satisfactory, he lays the groundwork for the kind of relationship he will have with people of the opposite sex. By his identification with the parent of the same sex he can affirm himself as a person in his biological and social role.

If his father's occupation is one which is fairly concrete and lends itself to being understood by a child of this age, a boy can get some notion of what being an adult is like and can by his imaginative play vicariously test this out. Girls are profoundly influenced both by their mother's attitudes towards them as individuals and by their mother's attitude toward the maternal role. Their father's interest and attitude towards them also have a great deal to do with whether they view being a girl and eventually a mother as a satisfactory and rewarding way of life. If the child finds that his curiosity gets reasonable approval by his elders and if there is at least tolerant acceptance of his imaginative exploration of adult life, he is now ready and eager for formal learning which he can begin to make use of creatively. It is not easy, however, for parents to accept the way preschoolers want to poke into and inquire into things. It is hard to have the energy and the patience to respond constructively to their endless questions or to accept the almost inevitable mess which attends their play. The mother who said, "Find out what the children are doing and tell them to stop," was undoubtedly speaking of children of this age period. Yet out of this can come a child's feeling of satisfaction and enjoyment in using his mind in finding out and in imagining. If this is too much stifled, he may not only have trouble in school, but also he may never dare to

really stretch and use his mind to the extent he is potentially capable of doing.

School Years

From about the age of six until the beginning of adolescence, life on the whole should flow reasonably smoothly and constructively. If the child has, in the first 18 months, developed a built-in sense of well-being within himself and his relationships to other people, and if from 18 months to three and a half years he has developed a sense of comfortable competence in the use and control of his physical body and has reasonable acceptance of his individual difference, and if from three and a half to six he gets the feeling of the rightness and joy of using his mind creatively as well as some feeling of the possibility and desirability of aiming for some adult life role, he is ready to enter into this constructive period when school bulks large.

Unfortunately not all children have satisfactorily worked through these preliminary stages. Some will have difficulty separating from home and parents and forming relations with their age mates. Some will have problems in relating to authority, both the authority of the home and the school and the authority of learning. They will have to put their energies into fighting against rather than doing. Some with their feelings of inadequacy and lack of achievement will try to make up for this by defiant antisocial behavior such as taking things which do not belong to them. Some whose consciences have been overstimulated will be restricted and guilty in the free use of themselves and their imaginations and may manifest this by nightmares. Stuttering, which is not uncommon as a transient phenomenon in the three to four year old, may now be relatively persistent when the child finds it difficult to show and express strong assertive feelings. Some too good children may put all their assertive energies into learning. Although they do well academically, they may be headed for trouble when, in adolescence, the increased intensity of their feelings makes such rigid control as they have previously exerted no longer possible.

Although it is the school-age, preadolescent child who is most frequently referred to child guidance clinics, one usually finds that the difficulties which brought about the referral stem back to unresolved problems of the preschool period.

Adolescence

The period of adolescence is measured best in physiological rather than chronological terms. It is the great transition period between childhood and beginning adult life. Concomitant with the physiological

changes is a tremendous increase in the intensity of all feelings. This increased intensity does not apply only to the more obvious sexual feelings. These feelings complicate the basic problem with which the adolescent is dealing, which is finding out what kind of reasonably independent person he can begin to be. This involves striking a balance between two different parts of himself. The first is the accepting and somewhat dependent, warmly relating side, which has been such an important element in his childhood, and the other is the more separating, more independent, more aggressive side. Both need to be constructively integrated into the person he is becoming. To bring these two sides into equilibrium is often a prolonged and difficult job.

Accompanying this is the adolescent's need to determine what role he dares to commit himself to as he moves into adulthood. Erickson[4] recently emphasized the point that the adolescent needs a period of "psychosocial moratorium." By this he means that the adolescent needs time and opportunity to test out a variety of different roles before finally committing himself to a particular role. Many adolescents by performing some delinquent acts test out the role of delinquency, but this is merely a trial, and they move on to some other more appropriate and socially constructive activity. In certain situations, however, the adolescent may have a role permanently thrust upon him before he has an opportunity to try out any others. Because adolescence is a period of transition with much testing of different roles, complicated by greatly increased intensity of feeling, all the unsolved problems of the past developmental periods are apt to make themselves manifested.

The too good child, when he encounters the intensified feelings of adolescence, may question his own sanity because he has never allowed himself to be aware of his disturbing thoughts and feelings before. If during childhood he handled his feelings by denial, he deprived himself of the important experience of learning how to deal with them. The result is that he is quite unprepared to cope with what he finds within himself during adolescence. Because of this and for other reasons, the adolescent often desperately wants help, but finds it hard to use because by accepting it he feels that he is weakening his own capacity to stand on his own two feet.

Many unresolved problems are brought to adolescence from earlier developmental periods, but if the relationship which exists between parent and child is not too tenuous, it will have the strength and stability to withstand the stress and strain inevitable to this period. Nothing is more tragic than to see parents, having almost lost contact with their child, doing in their desperation those things which further separate them from him. It is easy to make the mistake of taking at face value the adolescent's denial of the need for help which he frequently expresses, but never totally means. Adolescents can use direct-

ness better than almost any other age group, especially if it is not charged with despair or anger.

THE DOCTOR'S ROLE

One cannot speak of these developmental stages without also bringing in the tremendously important role which parent-child relationships play in determining how the stages are worked through. It is through his understanding of these developmental stages, and the difficulty of the troubled parents in constructively relating to them, that a practicing physician can play such a vital role in promoting healthy personality development. This can be accomplished by using his understanding of what is going on in the psychological growth process of the child as he helps, with sympathy and skill, the parents to examine and work through their questions and conflicting attitudes towards their child. If parents, as they talk with their physician, are provided with an opportunity to look objectively at what is going on in their child and their own relationship to it, they can often work out effective ways of coping with whatever difficulties are present. The problem for the physician in this is to have the necessary understanding, to have some skill in counseling the parents, and to be able to find the time within the structure of his practice to do it. Doctors are trained to get their satisfaction out of understanding and dealing with complicated medical problems. The area of successful parent counseling is as difficult and challenging and just as rewarding. However, physicians in training are not on the whole as yet given enough carefully supervised experience in this area so that they feel entirely comfortable or competent in doing it. As a result, the physician not only does not find it challenging and rewarding, but also often does not feel justified in charging for the amount of time involved.

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THE EDUCATION AND TRAINING OF CHILDREN WITH HANDICAPS

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Formal schooling for all American youth is a dream not yet fully realized for many children with handicaps. According to the biennial survey of education for 1952–3, there were 28,118,000 children enrolled in public schools. It is estimated that 10 per cent, or 2,811,800 children, are in need of special education services. In the same survey only 497,216 children, or 18 per cent of the estimated need, were enrolled in special adjusted services.*

In each new decade the schools have called fewer and fewer children uneducable. In the five year period 1947–8 to 1952–3, the enrollment in public schools increased 17.4 per cent, while the special class enrollment increased 47 per cent. At one time school was the privilege of the few. Now it is legally the right of all. Nevertheless, even liberal school systems are sometimes required to say to some parents, "Although your child is of school age, we have no program that will meet his needs." Even more frequently, the child is accepted, but no special program is available for the handicapped child.

AIMS AND COST OF SPECIAL EDUCATION

Early in the development of special educational facilities for children with handicaps the driving motive was improvement in learning opportunity for the nonhandicapped child. Without special class facilities an average class will have three or four children with handicaps. A teacher whose class contains pupils with handicaps is compelled to spend a disproportionate amount of time and effort with these children to the detriment of the class as a whole. School administrators promised

* *Statistics of Special Education for Exceptional Children 1952–53.* Chapter 5, Biennial Survey of Education in the United States, 1952–54. Washington, U.S. Government Printing Office, 1954, p. 6.

taxpayers that the small special classes were economical because teachers of regular grades could teach larger classes of nonhandicapped children. To achieve equal educational opportunity for handicapped children was and is costly, two to five times the cost of teaching children without handicaps.

One important roadblock to the establishment of special classes is the difficulty of recruiting and training teachers for these fields. Generally, the time and cost of training are equivalent to an additional year of college work and are superimposed upon the regular training program of the teacher. In many instances the extra training required and the special difficulties of teaching handicapped children are not recognized with any increase in salary. Teachers comfortably situated in teaching regular grades can hardly be expected to take the extra work and meet the difficult problems of teaching the special class.

In addition, school accommodations are more expensive for handicapped children. Two to three times as much floor space per pupil is required, as well as additional equipment for special services. In order to gather in one place enough children to warrant a successful special class, it is often necessary to include the children from a large geographic area. This involves bus or taxicab transportation to school, usually at public expense. For this reason many local school districts are reluctant to organize special classes unless much of the extra cost is borne by the larger community, the State.

In some cases the absence of special classes is rationalized because of the obvious need of children with handicaps to live and to adjust in a normal world, and also because the nonhandicapped need to understand and accept the handicapped. To many the connotations of "segregated special classes" are frightening and undemocratic. On the other hand, no child is more segregated and unhappy than the one who is excluded from the normal activities of class and playground because of his handicap. A blind child cringing against the wall in a school playground is not experiencing an integrated activity with his sighted fellows. The mentally retarded child, unable to understand or to keep up with his classmates, is frustrated and made unhappy by standards he is in no way able to meet. The struggles of the stutterer or the cerebral palsied child to speak while the class and the teacher wait intensify the child's problem and hinder the progress of other children.

Ideally, no child should be placed in a special class unless he is not able to maintain himself with reasonable comfort and without undue frustration in a regular class. For this reason placement in a special class should be a decision based on the totality of the situation—the nature of the regular class and of the handicap the pupil has, and the various compensations he has learned. The intellectually retarded child with adequate social graces, the crippled child or deaf child with intellectual

gifts can often adjust successfully to a regular class and enjoy its usually wider enriching experiences. On this basis many children may need temporary special class placement for a longer or shorter period in order to enable them to overcome a specific handicap and then to carry on their educational program in regular classes. This is particularly true of those who have defects in abilities to communicate, and who, with the aid of a special class program, could learn to communicate adequately with others.

The major concern of the schools is with learning. Handicaps that do not influence the learning function require no more adjustment of the pupils' programs than is afforded all pupils. Such adjustments involve adaptation of teaching methods to individual differences, and the use of the specialized services of counselor, physician, nurse, and social worker. It is certainly true that some handicaps such as cosmetic defects, minor dental defects, correctable visual, auditory and speech defects, posture, and so on, that children have influence their general and mental health. Such defects are dealt with in the normal program of the schools without special classes or a great deal of individual special help.

PROGRAMS FOR SPECIAL EDUCATION

Programs that require special classes or special teaching are adapted mainly to pupils in the following categories:

Children with Serious Loss of Mobility

Such pupils are those required to wear splints, casts, braces or crutches, or to be in wheel chairs. These are children with bone fractures, bone diseases, congenital deformities, poliomyelitic paralysis, involved cardiac cases, cerebral palsy, spina bifida, seizures, and so forth. The educational program for these children aims to continue normal learning with as little interruption as possible and to assist in the child's adjustment to the handicap, thus providing the basis for good mental health. Special classes for such children include orthopedic classes or special orthopedic school, hometeaching or hospital and institutional classes.

Children with a Serious Sensory Defect in Vision or Hearing

The aim here is to provide learning experiences that will minimize the child's sensory loss and to train the child in substitute methods to replace the lost sensory ability. Thus in classes for the deaf and hard of hearing, children are provided with a program that emphasizes visual

paths to learn, and at the same time the child is taught to communicate by speech reading and speech training as well as through auditory training in the use of hearing aids and group hearing amplification. Classes for the visually handicapped generally are of two kinds, depending upon the degree of visual loss. In the one with the lesser degrees of loss, the child may be taught to use all the visual ability he has. The school's program is adapted by the use of high intensity-low glare lighting, large writing on blackboards with railroad chalk, primer type widely spaced lines on writing paper, large type text books and magnifying devices. The program, however, is scaled as far as possible to that of normal children. For those children whose visual loss is severe, a basically different sort of approach is necessary, and the child is taught to read and to write braille. From that point on, his education is based on substitutes for sight: speaking, listening, the use of talking books, and braille.

Children with Speech Defects

In such cases the children usually remain in the regular classroom and receive speech training with a special teacher or therapist as part of their school program. Such speech training attempts to eliminate faulty speech habits and to train children in proper use of the speech organs, overcoming as far as possible anatomic and emotional handicaps.

Children with Mental Handicaps

These may be considered of basically two major kinds, retardation and functional emotional problems.

Mental Retardation. Generally the children who are retarded are classified according to the degree of retardation as educable or trainable rather than according to the etiology of the defect. The school's program is substantially altered to meet the need for extended preparation, frequent repetition, and concrete direct experience. There is reduced emphasis on vicarious experience and problem solving mostly to provide more emphasis on habit training. It is true that a great many individual problems exist in these groups, but as yet it is not common practice to organize separate classes for the uncomplicated types of mental retardation as distinct from the organic and functional.

Functional Mental Problems. The program for such children is designed to give them security in school through warm interpersonal relationships between teacher and pupil and pupil and pupil, through nonfrustrating expectancy of school achievement, and through special counseling services with referral to psychiatric clinics. Generally the environment in such classes is closely controlled and the activities of the children closely supervised.

Children with More than One Handicap

Most children who present one handicap also present another. Thus many retarded children have a speech handicap. Many cerebral palsy children are also mentally retarded. There are retarded blind children, blind deaf children, cerebral palsy children with seizures, and so forth. The general practice of the school placement for these children is to locate them in the school situation which gives attention to their most severe handicap, although in certain large organizations it is possible to group children according to at least two handicaps. Thus in a school for crippled children there may be classes for mentally retarded cerebral palsy children, or in a school for deaf children there may be classes for the mentally retarded deaf. The programs in such classes are adaptations of the general programs in classes for the children with the major handicap, with special services for the lesser handicap.

COMMUNITY PROGRAMS FOR SPECIAL EDUCATION

American communities vary greatly in their provisions for children with handicaps from no provision at all to the enrollment of 4 per cent of the school population in full time special class programs. In the United States as a whole, 1.8 per cent of the school population is reported to be in special classes including part-time services for the visually and speech handicapped. In full time programs for children with handicaps, only 0.6 per cent are in special classes; two thirds of these are classes for the mentally retarded.*

The Philadelphia School Program

Special education programs are more developed in the large cities than in the smaller towns and rural areas. The concentrations of the populations in the larger centers make it possible to provide special facilities for groups of children that are relatively small in comparison with the total population. Philadelphia may be taken as a typical large city community. Its provisions for handicapped children in the public schools are summarized in Table 10.

Speech and Hearing Defects. The largest number of pupils registered in a special education program are those in speech correction. With the beginning of each semester all the children entering Philadelphia Public Schools are examined by a speech correction teacher for speech defects. Those children with a defect are then scheduled for speech lessons in groups of seven or eight pupils at a time with a speech correction teacher who visits the school once a week. The speech cor-

* Derived from Table C, *Op. cit.*, p. 15.

TABLE 10. *Summary of Special Education for the Handicapped, Philadelphia Public Schools, Division of Special Education, February, 1957*

	ADMITTED BY	NO. OF PUPILS	NO. OF SCHOOLS	NO. OF TEACHERS	PUPIL AGES	NATURE OF PROGRAM
Speech correction	Examination of Speech Teacher	11894	256	41	6 to 21	Correction of severe speech defects Lip reading for children with minor hearing losses. One or more sessions per week.
OB, Elem. classes for educable mentally retarded	Recommendation of Public School Psychologist	2642	105	160	6 to 12	Readiness and basic school skills in social experience setting.
OB Center classes for educable mentally retarded	Recommendation of Public School Psychologist	4200	21	231	13 to 17	Basic school skills and job preparation in simplified social experience setting. Intensive instruction in shop skills and home arts.
OB Junior High classes for educable mentally retarded	Recommendation of Public School Psychologist	347	3	19	13 to 17	Basic school skills and job preparation in junior high school setting.
OB Senior High classes for educable mentally retarded	Recommendation of Public School Psychologist	261	2	13	15 to 17	Basic school skills and job preparation in senior high school setting.
RT Classes for trainable mentally retarded	Recommendation of Public School Psychologist	243	5	24	8 to 16	Social acceptance, learning to play and work in groups, training in health, safety, cleanliness, helpfulness in home and community.
OD Classes for socially and emotionally maladjusted	Referral of District Superintendent	575	1	41	6 to 17	Elementary and junior high program in social experience setting. Rehabilitation, restoration to grade and job placement are goals.

Orthopedic classes	Recommendation of Orthopedic Staff of Div. of Medical Services and Psychologist of Div. of Special Education	428	1	26	4 to 21	Full elementary and secondary education from kindergarten to graduation from high school. Special therapies (speech, P.T. and O.T.).
Classes for deaf and hard-of-hearing	Recommendation of Otological Staff of Div. of Medical Services and Psychologist of Div. of Special Education	201	1	23	4 to 17	Full elementary and junior high school program with special facilities for training in speech. Provision for transfer to senior high and vocational schools.
Classes for visually handicapped	Recommendation of Ophthalmological Staff of Div. of Medical Services and Psychologist of Div. of Special Education	170	1	15	4 to 17	Full elementary and junior high school program with specialized adaptation for visual handicaps. Provision for transfer and follow-up adjustment services in senior high and vocational schools.
Blind		5	1	1		
Hospital classes	Recommendation of Hospital Staff	196	8 (Hospitals)	13	4 to 21	Elementary and secondary program to maintain progress for Hospitalized pupils.
Home school	Certificate of attending physician approved by Divisions of Medical Services and Special Education	208	1	27	6 to 21	Elementary and secondary program to high school graduation to maintain progress for home-bound children.
English for pupils of foreign language background	District Superintendent	221	2	8	6 to 17	Fundamentals of English for transfer to regular grades.
Total No. in Special Classes except Speech Correction		9687				Total Public School Enrollment 223,464

rection teacher continues with the speech handicapped child until the defect has been corrected or until a maximum amount of improvement has been recognized.

Children who are found to have hearing losses in the classroom or in biennial complete medical examinations are given an audiometric examination. If the hearing loss is not sufficient to warrant the placement of the child in a special class for the deaf and hard of hearing, the child will be referred to the speech correction teacher. These children are then taught speech reading and are given the help of the regular grade teacher, such as preferential seating, clear enunciation on the part of the teacher, and allowing the light to fall directly on the teacher's face.

In certain instances speech correction is an especially important problem, such as in the classes for cerebral palsied children or for mentally retarded children of trainable level. Much more time there is given to the speech correction service. In some cases the speech correction teacher teaches the entire class. In other cases the children will have several speech correction lessons a week.

A public school for children who are deaf or hard of hearing is maintained by the Board of Education. This school enrolls, for a day-school program, about two thirds of the seriously deafened children in Philadelphia. The other third are enrolled in a private residential school located within the city limits. For admission to the day-school program, applications are reviewed by a committee consisting of an otologist, an audiometric technician, a social service counselor, a speech therapist and administrators of the school's program. Each case is considered carefully in its totality, and if the hearing loss, as shown by the pure tone audiogram and a speech threshold test, is great enough to warrant placement in this school, the child is next considered from the standpoint of the psychological findings and the social situation. A special psychological examination adapted for the deaf is used. When all evidence points toward placement in a special school, arrangements are made that the child be brought by school bus from any part of the city. The school's program is adapted for the usual elementary and junior high school grades and for the mentally retarded with the return of the children to regular elementary and secondary schools as soon as they have mastered sufficiently the difficult skills of speaking and speech reading.

Mental Retardation. Exclusive of the part-time work in speech correction, the largest number of children enrolled in special education programs are those in full time day school programs for the mentally retarded. Most retarded children are in the educable classification. Many children in the educable mentally retarded group are not really "discovered" until they enter school. The teachers' observations of chil-

dren who fail to learn in the early years of school, who exhibit infantile emotional characteristics and are generally out of step with the remainder of the class are reported to the central psychological service for a special examination. If the psychologist corroborates the evidence of the teacher, the child is recommended for placement in a special class for the mentally retarded, usually in the elementary school which the child has been attending. Sometimes the retardation becomes apparent only when the child is ready to be promoted to a secondary school. In these cases the children may attend one of the regular junior high schools that have special classes or, if the retardation—particularly on the social and emotional standpoint—is more severe, he may be assigned to a special class center for older children.

During the elementary school years, up to age 12, the educable mentally retarded child is given a program leading to readiness for reading and the development of his basic school skills—usually through what is called social experience activities. In these programs the children talk and write about daily happenings and special events planned by the class and the teacher. The material of these programs furnishes exercises in reading, spelling and writing, and frequently in arithmetic, social studies and science. In addition, the children will use reading textbooks graded two, three or four years below the age level of the child. Number experiences are kept at a practical level and restricted to the simpler phases. Many of these children learn to add with accuracy, and with some speed. They are slower in learning to subtract, much slower in learning to multiply, and frequently never learn to divide except in the simplest sense. Teachers consider it is important to provide the child with experiences in which he can be successful.

As the child progresses in age he will be transferred to a special class center or to a junior high school where the basic school skills in language and numbers are further developed and where emphasis is given to personal and social adjustment and to the problems of employment. Thus reading material will be derived from "want ad" columns, writing from application blanks; social studies content will follow from study of social security requirements. Practical experience in visiting places of employment is supplemented by the placement of some pupils in the training programs of the vocational schools and in part-time employment part-time school programs. In such cases the work experiences of the children furnish the background for the school's curriculum.

The more severely mentally retarded children who are classified as uneducable are often identified much earlier because of the severity of their handicap. Such children are frequently examined by psychologists at age six with a recommendation that the child have further training at home before admission to school. Such further training includes such essentials as the establishment of clean toilet habits and fostering of

ability to play with others and to make his wants understood. If the severely retarded child is trainable, he may be admitted to a special class at age eight. Children attending these classes are transported by school bus from various parts of the city to five centers where the children are taught to live and play together, given training in common health, safety and cleanliness habits and taught to be as helpful as possible in the home and in the community. If the child is believed to be untrainable, he is examined several times before he reaches the age of 12. If the prognosis then is still untrainable, he is excused from school attendance.

Social and Emotional Disturbances. Children who evidence social and emotional disturbances by aggressive acts are recommended by their teachers and principals for placement in special classes for the socially and emotionally handicapped. Philadelphia has two day schools for such children, one for girls and one for boys. Upon assignment to the special schools the child is studied through placement in a vestibule class to find out in what part of the school he or she will make the best adjustment. The placements are made on the basis of personal adjustment to teachers and other pupils, as well as according to academic and social needs. The school's program is arranged to provide as few frustrating experiences as possible. The teachers are warm and friendly, but firm. Much counseling help is given by trained social workers, and frequently child guidance clinics connected with local hospitals cooperate closely with the schools in an integrated program of therapy. The pupil is under supervision during the entire time he spends in school. As a result of the controls in this type of program, behavior problems are minimized, and over a longer or shorter period the child comes to accept authority relationships, and may be returned to his regular grade. In some cases the child may reach the end of the period of compulsory school attendance and be excused at age 17. In other cases the pupils reach legal employment age, 16, and obtain jobs. Pupils are helped to obtain jobs by the school.

In addition to the two special day schools for socially and emotionally handicapped children, the Philadelphia Public Schools provide special teaching service at the Youth Study Center for children arrested by the police and detained temporarily in the Center. Although its temporary nature precludes the completion of an educational program, the classroom experience gives a measure of normality to an otherwise abnormal situation for the disturbed child.

For truant boys and for boys whose emotional involvements stem from inadequate home conditions, the Philadelphia School District maintains a residential school located in a farming area at the edge of the city. Some of the children attending this school, as well as those

attending the day schools, receive special psychiatric therapy at the Philadelphia Child Guidance Clinic and the Child Study Center.

Orthopedic Defects. For children with a serious loss of mobility or other orthopedic defect the Philadelphia School District provides a special school. The children are admitted to this school on the basis of recommendations of a committee consisting of pediatricians, psychologist, school physician, orthopedist, physical therapist, social service counselor and school administrators. The children are transported to the school from all parts of the city by school buses. They are provided with a complete elementary and secondary school program. In addition to regular teaching service, the school has a staff of physical and occupational therapists, working under the directions of the school's orthopedist. There is also a speech therapy department. The school has a brace shop that adjusts and maintains the braces of children according to the directions of the orthopedist. Considerable help is also obtained from volunteers to serve in the school. In many of the classes the children remain in specially made wheel chairs or stand tables during their regular lesson periods. School matrons assist with the toileting and feeding of some children. Special classes are arranged according to age and grade level, as well as according to degree of mental retardation. A physical education program, a swimming pool, and a shop program leading to the development of arts and crafts are all part of the regular school program. Upon completion of the program the child receives a diploma with a local high school graduating class.

Other children with a greater loss of mobility may be confined to home or hospital. A corps of visiting teachers provides two lessons a week for those children whose physicians request this service. This program is designed to maintain the child in the school work so that he can return to regular grade without serious loss of time. Speech therapy service is available to home-bound and hospitalized children. In some cases the child's handicap may be so disabling and permanent that his entire school program will be home-bound. In certain hospitals with large child populations public school teachers are permanently assigned to maintain the educational progress of the children. In other hospitals with occasional children as patients, the home visiting teacher will provide bedside or group teaching. These teachers follow, as far as possible, the regular courses of study in the Philadelphia Public Schools, so that when a child is capable of returning to school he will maintain his status with his grade. Frequently a child will be transferred from a hospital to the home, in which case he will receive further home-bound instruction. One recent innovation is to provide teaching service in two mental hospitals.

Visual Defects. Classes for the visually handicapped are organized in a regular elementary school as a special program. In this school

children who are going to be educated on the basis of maximum use of residual visual ability are selected by a committee consisting of an ophthalmologist, a psychologist, a social worker-counselor and members of the administrative staff of the school. In like manner children who are blind are selected, after ophthalmological and psychological examinations, for a braille program. In Philadelphia, however, most of the blind children are cared for in a local private residential school.

Other Schools. The foregoing description of a public school program for children with handicaps is only part of a community's effort to educate and train its children. Previously mentioned are a large privately managed residential school for the deaf and one for the blind. Residents of the state may send children to these schools free of cost. The diocesan school system has schools for retarded, deaf and blind children. Parents' associations maintain nursery classes for the retarded, deaf and blind, and sheltered workshops for the retarded and blind. The Commonwealth maintains a speech and hearing evaluation center and a rehabilitation agency. Sheltered workshops are maintained by two charities. There is a central referral agency for rehabilitation. A number of private day and boarding schools accept crippled, retarded or emotionally disturbed children. A hospital operates a nursery school.

The Pediatrician and the Community Program

A pediatrician will normally come into intimate contact with the resources of his community for the special education of children with handicaps. In most large communities the superintendent of schools or the director of special education or of medical services will know the available resources not only of the public schools, but also those of other agencies. In smaller communities it may be necessary to get in touch with the county superintendent or the state superintendent.

The pediatrician not only has the responsibility to know and to evaluate his community's facilities for special educational services for the handicapped, but also he should be prepared to furnish the schools with accurate descriptions of children's individual educational needs as he sees them. As an important member of the community he can interpret the needs of children with handicaps to the public and to the school administrators. Only in the partnership of the medical profession and the schools can we hope for more complete attainment of an educational program for children with handicaps.

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THE COMMUNITY AND THE HANDICAPPED CHILD

CARL C. FISCHER, M.D.

A careful review of the preceding clinics provides the individual practitioner of medicine with the current attitude on the prevention and care of children with handicaps.

The authors have stressed the more recent or horizontal viewpoint in which the total care of the child with its interlocking physical, emotional, educational and social implications is predominant, rather than the older and more classical vertical viewpoint of considering each handicap on the basis of its anatomical delineations.

This same careful review should serve to convince the individual practitioner that, regardless of his own personal knowledge or experience, the total care of any child with a handicap has outgrown the ability of any individual to meet them successfully.

The only solution, then, would seem to be the development of a total care program within the community, and it is for this reason that this clinic on the community and the handicapped child has been placed at the end of his volume.

Unfortunately, in this respect, medical men have for generations been traditionally individualists and have tended, with few exceptions, to avoid accepting the leadership in problems of a socio-medical realm such as this. Consequently, many of the other groups interested in this problem have been forced to assume the leadership, and the medical profession has relinquished a field of service in which it is badly needed. It is hoped that this review of the topic will serve to remind some physicians of their responsibilities in accepting leadership in this field.

Few communities, including some of those with the largest and best equipped medical centers, have as yet reached the goal of properly integrated community services for the handicapped child. A good deal has been written upon this subject, and a number of detailed plans for

community action have been outlined. For these we refer you to the references at the end of this clinic and will be content simply and briefly to call attention here to some of the multiple phases of this problem.

A. R. Shands, Jr., Medical Director of the Alfred I. duPont Institute of the Nemours Foundation (which group has sponsored a number of statewide meetings looking toward the establishment of such community programs), likes to think of the problem of community needs for the child with a handicap as epitomized by five E's. These five E's, he states, are (1) enumeration, (2) evaluation, (3) education, (4) eradication, and (5) emancipation.

ENUMERATION

Taking these one by one, enumeration would seem to be a logical starting point for any community project, by ascertaining, first, just how serious the problem is in each particular community; secondly, what are the special needs of each community; and, finally, what facilities now exist and what additional ones are needed.

This phase of the program alone is a broad and difficult one. Present general estimates give some indication of the broadness of this problem and are of distinct value as guides. Wishik estimates that 10 per cent of all children have some type of handicap, that of these one third have only one handicap, an additional third have two handicaps, and the final third multiple handicaps. Put another way, his studies in Georgia suggest that the number of children per 1000 under 21 years of age having each of the following type of defect may be estimated as follows: cosmetic, 43; mental retardation, 40; personality disturbance, 29; speech, 29; eye and vision, 24; hearing, 19; orthopedic, 17; orthodontic, 16; cardiac, 10; cerebral palsy, 5; epilepsy, 4; cleft palate and lip, 1. Because of the multiplicity of defects in at least two thirds of this group, this results in a total of 237 defects per 1000 children, a truly astounding figure.

The problem of estimating these needs in each community depends, of course, on the individual facilities in that community. Properly developed local health units, a full and satisfactory school health program, and well integrated health and welfare agencies might combine in such a project. In any event, it is important to remember that the mere collection of figures is not in any sense a solution of the problem. For a more complete review of the problems of case finding, reporting and case registers the reader is referred to section three of the American Public Health Association's excellent booklet on "Services for Handicapped Children."

EVALUATION

Our second "E," evaluation, means, of course, adequate diagnosis and complete planning for total care.

Such a program necessarily entails the development of diagnostic centers where the multiple phases of any child's handicap in all the outlined realms above can be properly studied and an over-all plan for care outlined. Here, again, it is obvious that leadership is necessary in order to coordinate the many well-meaning although sometimes ineffectual groups who might be working independently in the field in any single community.

EDUCATION

Our third "E" stands, as you will remember, for education. In many respects this is perhaps the most important of all from the community standpoint.

This is one of the conditions to which we may aptly apply the old saying, "It is not sufficient to comfort the afflicted; one must also afflict the comfortable." By this we mean that the smugness of the community and the failure of the general public to face squarely the immensity of this problem must be overcome. Logically, such education must be of multiple types.

The first of these would be the education of the patient into the understanding of himself and his problem. This may tax the skill and ingenuity of the parents, the family physicians and others to the limit and may require the services of a psychiatrist to assist in aiding the child to adjust successfully to the problems associated with his handicap.

Secondly would come the education of the family. Until comparatively recent times it was customary for the family to keep problems of handicapped children hidden. This was especially true if the handicap happened to be mental retardation or a psychiatric problem. Only recently have people come to realize that illnesses of this type are no more a disgrace than any other illness and that they must learn to live with the problem and to aid the child to make the best possible adjustment after they themselves have adjusted satisfactorily to the situation. The physician, the minister, priest or rabbi, the teacher, and other community leaders all play important roles in bringing about this adjustment. Recently parents of children with specific types of handicaps have banded themselves together into study groups, and this has been most helpful to them in finding strength and wisdom to combat their problems. The physician can often be of help in guiding parents to such groups or in aiding in their formation and the guidance of their programs once they are formulated. One note of warning, however, needs to be sounded on the question of the development of a number of

special groups dedicated to the consideration of one particular entity. This is that if large sums of money are contributed to the study of individual diseases, much money may be diverted from basic research which, although unrelated to the immediate problem at hand, is all-important for future progress. For this reason such groups should be urged to set aside certain percentages of their income to stimulate and support basic research even though it may not have any apparent direct bearing upon the condition in which they are primarily interested.

One of the main problems is the question of whether or not a severely handicapped child could be best cared for in his home or in an institution. This problem is particularly difficult when the handicap is mental retardation, but it has become increasingly recognized that so far as it is possible, it is most important for the child to be kept in his natural environment in order to give him the best possible opportunity to develop. Only when the child's presence in the home creates further problems within the family itself or when remaining in the home makes it impossible for the child to receive such benefits in the way of instruction and training that would be possible in an institution specially prepared for the care of such children should the matter of removing him from the home be considered. Here, again, the physician can play an important role in aiding the parents toward making the proper decision.

Next we have the education of the profession and of the many ancillary workers required. Medical schools should put more time and effort into the discussion of the problems of the handicapped and their correction, and many trained workers are needed in all the ancillary branches of the healing arts and can be vitally important to these children.

Finally, education of the community at large is essential if any community-wide program is to be successful. This means the organization of a cooperative effort by all the governmental, private and other agencies concerned and the guiding of their combined efforts toward a common goal.

ERADICATION

Our next "E" is that of eradication. Eradication, of course, means the prevention of the handicap whenever possible. This phase has been covered in the earlier clinics of this volume. We would only like to re-emphasize here that the handicapped child is as deserving of total preventive pediatrics as is any and every other child so that all the generally accepted methods and measures of preventive care should be applied in even greater measure to such children.

In those cases in which prevention is not sufficient we must have, of course, rehabilitation and the correction of the defect by all known

means. Here, marked progress has been made in recent years with, of course, considerably more to be done, and it is essential that all community resources be adequately utilized toward this goal.

EMANCIPATION

The final "E" which Dr. Shands suggests is that of emancipation or the transference from dependence to independence, the end result of the proper application of the preceding four "E's."

CONCLUSIONS

In conclusion it might be well for us to stop and consider once again what we mean by a handicapped child. Accepting the definition as printed in "Services for Handicapped Children," we can say, "A child is considered to be handicapped if he cannot within limits play, learn, work, or do the things other children of his age can do; if he is hindered in achieving his full physical, mental, and social potentialities."

From such a broad definition it must be obvious that the scope of the prevention and care of handicaps in children is as broad as that of pediatrics itself, and for this reason we would like to stress once again that in this field our goal must be, not the care and treatment of handicaps, but the total care of a child with one or more handicaps.

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THE RESPONSIBILITIES OF THE MEDICAL PROFESSION IN THE USE OF X-RAYS AND OTHER IONIZING RADIATION

STATEMENT BY THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION

1. The United Nations General Assembly, being aware of the problems in public health created by the developments of atomic energy, established a Scientific Committee on the Effects of Atomic Radiation. This Committee considered that one of its most urgent tasks was to collect as much information as possible on the amount of radiation to which man is exposed today, and on the effects of this radiation. Since it has become evident that radiation due to diagnostic radiology and to radiotherapy constitutes a substantial proportion of the total radiation received by the human race, the Committee considers it desirable to draw attention to information obtained on this subject.

2. Modern medicine has contributed to the control of many diseases and has substantially prolonged the span of human life. These results have depended in part on the use of radiation in the detection, diagnosis and treatment of disease. There are, however, few examples of scientific progress that are not attended by some disadvantages, however slight. It is desirable, therefore, to review objectively the possible present or future consequences of increased irradiation of populations which result from these medical applications of radiation.

GENERAL SURVEY OF THE IRRADIATION OF HUMAN BEINGS

3. Man has always been exposed to some irradiation from natural sources. To this has now been added, as a result of modern discoveries

and the applications of ionizing radiation and radioactivity, certain forms of artificial irradiation.

4. *Natural irradiation* is due to (1) cosmic radiation, (2) "background" gamma radiation from radioactive substances present locally in the earth, rock or building materials, and from disintegration products of radon in air, (3) radiations emitted from natural radioelements such as potassium 40, radium, radon and carbon 14 which are incorporated in the body.

5. The amount of this natural radiation varies with locality, but has been estimated as usually delivering between 70 and 170 millirems per year to the gonads. Of this total, the main contributions are of about 45 per cent from local gamma radiations, 30 per cent from cosmic rays and 20 per cent from body potassium 40.*

6. *Artificial irradiation* is derived from (1) the contamination of the environment, the atmosphere or water by radioactive waste from atomic industries or from users of radioelements; (2) the radioactive fallout, at greater or lesser distances from the source, or radioactivity resulting from the explosion of nuclear devices; (3) the occupational exposure of certain groups of workers: medical practitioners, radiologists, dentists, nurses, atomic energy workers, uranium or thorium miners, and the industrial or scientific users of radiation generators or radioactive isotopes; (4) the medical use of x-rays, other ionizing radiations and radioelements in the detection, diagnosis, investigation and treatment of human diseases; (5) the use of certain devices which emit radiation, such as television receivers, watches with luminous dials, and the x-ray generators used for the purpose of fitting shoes.

7. The amount of artificial radiation must vary considerably in different countries, and we have inadequate information as to the over-all significance of these factors. In certain countries where estimates have been made it appears that the greatest gonad irradiation of the population is due to diagnostic radiological procedures, the amount from this source about equalling that from all natural sources in certain instances. The total present contribution from occupational exposure, from the products of atomic industries, from radiotherapy and from the radiating devices mentioned above (paragraph 6, subparagraph 5) is likely to be considerably smaller. That from radioactive fallout to the gonads appears at present to be in the region of 1 per cent of the natural gonad irradiation in most areas.†

8. Both the magnitude and the significance of these various sources are under review by the Committee. Since medical irradiation accounts

* From reports sent by India, Sweden, the United Kingdom and the United States of America.

† According to the reports sent by the United Kingdom and the United States of America.

for a substantial if not the main proportion of all artificial exposure, it is important that its magnitude should be known accurately for different countries and circumstances. The possibility of making such an assessment depends upon the help of the medical profession, and particularly on the adequacy and availability of records kept by doctors, dentists and organizations responsible for the use of ionizing radiation.

RADIATION HAZARDS

9. The medical use of radiation is clearly of the utmost value in the prevention, diagnosis, investigation and treatment of human disease, but the possible effects of this irradiation of individuals require examination.

10. Generally speaking, the irradiation of living beings may produce radiobiological effects either on the irradiated person himself or, through him, on his descendants; the former are termed somatic and the latter genetic effects. Somatic effects vary according to the different organs or tissues affected, and range from slight and reversible disturbances such as cutaneous erythema to the induction of leukemia or other malignant diseases. The possible reversibility of the somatic effects of radiation received in small doses or at low dose rates encourages the belief that there are permissible doses of radiation which will not cause completely irreversible or significant somatic damage. The threshold for occasional somatic damage may, however, be low. In the case of genetic effects, on the other hand, there may be no threshold. These effects increase with a frequency corresponding to the total amount of radiation received by the germinal tissues, and in the great majority of cases are adverse.

11. Many other factors complicate the interpretation of radiobiological effects. The differences between whole and partial body radiation, between a single exposure and continuous irradiation, or between the effects of different types of radiation are still imperfectly understood. Biological differences in the radiosensitivity of various tissues, or of the tissues of people of different age or sex, obviously influence the nature of radiation hazards. It is clear, however, that any radiation of gonads, and any substantial irradiation of other tissues, involve a chance of significant damage which requires assessment.

GENERAL RECOMMENDATIONS REGARDING THE MEDICAL AND OCCUPATIONAL IRRADIATION OF HUMAN BEINGS

12. The Radiological Profession, through the International Commission on Radiological Protection,* has undertaken a valuable and

* See the report of the International Commission on Radiological Protection, published in the *British Journal of Radiology*, Supplement 6, December, 1954; in the *Journal Français d'electro-radiologie*, No. 10, October, 1955; etc.

responsible duty in defining maximum permissible limits of exposure for the main radiation hazards.

13. The establishment of these maximum permissible levels for those who are occupationally exposed to radiation depends on the view that there are doses which, in the light of our present knowledge, do not cause detectable somatic injury in the person irradiated; and on the consideration that the number of persons concerned is small enough for the genetic effects on the whole population to be negligible. For the gonads, or for irradiation of the whole body, the levels are such as to exclude doses greater than 0.3 rem in any week or 3.0 rems in any 13 weeks, or a sustained irradiation rate greater than 5 rems per year. These values imply that no total dose of over 50 rems will have been received by the gonads by the age of 30, or of over 200 rems by the whole body by the age of 60, in any occupationally exposed person.*

As regards irradiation of the whole population, it is considered prudent to limit the average dose to germinal tissues from artificial sources to the order of magnitude of that received from all natural sources.

14. In considering the extent to which the population is irradiated for medical purposes, it is essentially the genetic hazard which is involved, although it seems possible that in certain circumstances somatic injury may occur occasionally after low doses of radiation. Otherwise, the relevant dose is that indicating the mean gonad irradiation among the population as a whole up to the end of the average reproductive period.

15. The extent of such genetic irradiation from diagnostic procedures has been found to be equal to at least 100 per cent of all natural radiation in two countries,† and that from a third equalled at least 22 per cent of this figure.‡ Even before obtaining more exact values for these and other countries, it is clear that the exposure can be substantial in countries with extensive medical facilities, and that it is essential to consider any ways in which this exposure could be reduced without detriment to the existing or developing value of medical radiology.

16. The Committee is therefore anxious to obtain the help of radiologists in suggesting through appropriate governmental channels any methods by which this total exposure could be reduced and in estimating the amount of reduction that might be expected from any such methods. In particular it would be valuable to know how much the radiation to the gonads could be reduced, (*a*) by improved design or shielding of equipment, (*b*) by fuller training of any persons using radiographic or fluoroscopic equipment, (*c*) by any local shielding of

* See the report of the International Commission on Radiological Protection, published in the *British Journal of Radiology*, Supplement 6, December, 1954; in the *Journal Français d'electro-radiologie*, No. 10, October, 1955; etc.

† Sweden, United States of America.

‡ United Kingdom.

the gonads that is practicable, especially during abdominal or pelvic examination, (*d*) by the use of techniques involving radiography rather than fluoroscopy when full information can be obtained by this means, (*e*) by improvement of administrative arrangements designed to obviate unnecessary repetition of identical examinations of the same subject, (*f*) by a general study of certain medical conditions such as that of peptic ulcers, to identify the circumstances in which the establishment of a radiological diagnosis has or has not a definite influence upon the treatment or prognosis.

SUMMARY

1. The Scientific Committee on the Effects of Atomic Radiation established by the United Nations General Assembly accepts the view that the irradiation of human beings, and especially of their germinal tissue, has certain undesirable effects.

2. Information received so far indicates that, in certain countries (Sweden, United Kingdom, United States of America), by far the most important artificial source of such irradiation is the use of radiological methods of diagnosis and that this may be equal in importance to radiation from all natural sources. It is possible that such radiation may be having a significant genetic effect on the population as a whole.

3. The Committee is fully aware of the importance and value of the medical use of radiations, but wishes to draw the attention of the medical profession to these facts and to the need for a more accurate estimate of the amount of exposure from this source. The help of the medical profession would be most valuable to make it possible to obtain fuller information on this subject.

4. The Committee would be particularly grateful for information through appropriate governmental channels on ways in which the medical irradiation of the population can be reduced without diminishing the true value of radiology in diagnosis or treatment.

United Nations
New York

TOTAL BILE DUCT ATRESIA

JULIAN A. STERLING, M.D.

Total bile duct atresia is inevitably fatal.[12] The possibility for relief of this condition depends upon the availability of an extrahepatic segment of the biliary tract and its capacity to drain normal intrahepatic tissue. In such infants, normal function can be re-established by anastomosis between the available hepatic duct segment and the intestinal tract.

During the past year three patients have come under my observation because of total extrahepatic bile duct atresia. In these an external bile fistula was inaugurated by the establishment of multiple tube hepatostomies at the liver hilum. Two patients continue under observation.[23] One recently died. This last child, who survived to the age of four years, is of scientific importance because of the facts associated with her survival and the circumstances of her death.

Pertinent anatomic and developmental facts relating to congenital biliary duct atresia have been well explored.[3, 5, 6, 9, 12, 16, 26] This state, with its associated obstructive jaundice, is fatal. Death is due to impaired hepatic function and associated cirrhosis and portal hypertension.[5]

Failure of bile excretion produces disorganization and abnormalities in structure and function of the hepatic parenchyma. On the other hand, an external bile fistula, per se, is not associated with these changes, and, in fact, indefinite life is possible.[24] In cases of total bile duct atresia, then, it might be advantageous to inaugurate an external bile fistula. As a result, production of cirrhosis and portal hypertension might be obviated. Eventually the external fistula could be converted to an internal one.[19] The primary objective, however, in treatment of infants with congenital biliary duct atresia is to overcome the obstructive jaundice[24] and thereafter to provide a proper route for bile flow.

CASE REPORT

C. P. was born on November 6, 1952, weighing 6 pounds, 10½ ounces, as a normal full-term female. The infant was pale. She had light-colored bowel movements and

TABLE 11. *Representative Laboratory Studies (from Records of New Britain General Hospital and the Albert Einstein Medical Center, 1952–6)*

	DECEMBER 1952	JANUARY 1953	APRIL 1953	SEPTEMBER 1953	NOVEMBER 1953	MARCH 1954	NOVEMBER 1956	
Hemoglobin (gm. or %)	60%		58%	12%(1.8 gm.)	26%(7.8 gm.)	4.9–12.6	7.3–6.5–12.4	
RBC (millions)	2.7		3.1	1.6–3.8	1.7	2.8		
WBC (thousands)	9.1		13.7	21			2–7.8	
Platelets							130,000–92,000–101,000	
Urine:								
urobilinogen (mg. %)	0.01	0.02		0.003				
bile	3+		3+		3+			
Stool:								
bile	Neg.		Neg.				Neg.	
blood								
Serum bilirubin (mg. %):								
direct	8.0	7.8				8	12.5	9.9
indirect	2.4	2.8				3	8.3	10.1
total	10.4	10.6				11	20.8	20.0

Alkaline phosphatase (Armstrong units)	24.3			
Cephalin flocculation	Neg.			
Prothrombin time (% of normal)		52	47	65
Sodium (mEq./L.)				129–133
Potassium (mEq./L.)				4.6–5.4
Proteins (gm. %):				6.4
A–				2.0
G–				4.4
Chlorides (mEq./L.)				98
Carbon dioxide (m. vols.)				18
Calcium (mg. %)				8.2

dark urine. In December, 1952, the infant had jaundice. She was hospitalized, then, at the New Britain General Hospital for studies by Dr. William T. Livingston. During this first month of life she had gained 3 pounds in weight, and was normally developed and nourished. Physical examination was normal except for jaundice and hepatosplenomegaly.

Laboratory examinations revealed anemia (2.7 million red blood cells per cubic millimeter), and jaundice (total serum bilirubin was 10.4 mg. per 100 ml.; direct was 8.0 and indirect 2.4 mg. respectively). Alkaline phosphatase was 24.3 Armstrong units. Blood indices, bleeding and clotting times were normal. Erythrocyte fragility was significantly less than normal.

Duodenal drainage obtained no bile.

Radiographic studies revealed no abnormalities in the intestinal tract.

Operation was performed on January 8, 1953. Liver biopsy revealed biliary cirrhosis and pericholangitis. The liver was enlarged, irregular, granular and green. A gallbladder was identified. This contained clear mucoid fluid. Injection of the gallbladder with saline solution indicated flow through a thin cord toward the duodenum. A fibrous cord was identified replacing the hepatic ducts. The arterial and venous circulations of the liver were intact and normal.

The patient was transferred to New York City and operated on by Dr. W. F. Ruggiero at the Flower-Fifth Avenue Hospital. The left lobe of the liver was anastomosed to the stomach in March, 1953.

Gastrointestinal bleeding was thereafter continuous. Multiple blood transfusions were required to correct hemoglobins of 1.8 or 2 gm. on many occasions, but the child eventually recovered and grew despite maintained jaundice and almost constant melena. There were approximately 26 hospital admissions through November, 1956, during which blood transfusions were given to correct the hemorrhagic anemia and paracentesis was done to relieve ascites.

The child was admitted to the Northern Division of the Einstein Medical Center on November 11, 1956, at the age of 4 years. She weighed 40 pounds and was not ambulant except with support in a walker. She was pale, greenish, dry and spindly, and had a tremendously protuberant abdomen. Huge veins coursed over the abdominal skin. Hepatosplenomegaly was marked. Ascites was present. At the time of this last hospitalization the child's hemoglobin ranged from 6.5 to 7.3 gm. There were 2000 to 7000 white blood cells per cubic millimeter. Platelets averaged 100,000 per cubic millimeter. Serum bilirubin was 20.8 mg. per 100 ml., serum proteins were 6.4 gm. with a 1:2 ratio and marked hypoalbuminemia. Serum calcium, sodium, potassium, chlorides and carbon dioxide determinations and flocculations were normal. Prothrombin time was 65 per cent (Table 11).

X-ray examinations revealed the presence of esophageal varices, hepatosplenic enlargement and fixation deformity of the pyloric portion of the lesser curvature of the stomach (Fig. 22). The child was operated on November 19, 1956. Intravenous sodium pentothal was used for induction, and anesthesia was maintained by a nonrebreathing system with cyclopropane, nitrous oxide, oxygen and trilene. The abdominal wall was prepared and draped.

Dr. Samuel Levine inserted a 15-gauge needle into the spleen and injected approximately 25 cc. of 50 per cent Hypaque. This attempt at splenoportography was unsuccessful, since the contrast medium remained in the spleen.

Laparotomy was then undertaken through a slightly oblique-transverse incision extending from the right anterior superior spine to the left costal margin. Adhesions were freed from the bowel, stomach and colon to the liver. During mobilization of the stomach to gain access to the hilum, the gastric-hepatic lobe anastomosis was separated. The stomach could not be fully mobilized. Accordingly, the hole in the stomach was closed with great difficulty by interrupted silk sutures.

A small cystic structure (approximately 1.5 cm. in diameter), which may have represented the gallbladder, was opened and a small mushroom catheter sutured in place.

It was possible to separate the liver lobes at the hilum. Adhesions were incised and

dissected as close as possible to the portal vein. Eight Southey tubes* were inserted into the hilum. Polyethylene (P E 280; internal diameter 0.085 inch) was attached to each Southey tube. These were gathered, like a bundle of faggots, to emerge through the incisional area. Thin rubber tube drains were placed lateral to the hepatostomies, in the inferior subhepatic spaces. The abdominal wall was closed with chromic catgut for the peritoneum, and through-and-through wire sutures.

When the Southey tubes had been first placed within the liver, clear fluid, bile-stained fluid or blood escaped. If blood flow was exceptionally brisk, the Southey tubes

Fig. 22. Roentgenogram of stomach and duodenum. The upper gastrointestinal tract was examined after introduction of a naso-esophageal tube. The distal half of the esophagus is dilated, and extentive filling defects, representing large esophageal varices, are seen within the lumen of the esophagus. The stomach is normal in size, but abnormally situated. Its axis is anteroposterior rather than cephalad-caudad. Hepatosplenic enlargement is present. (Courtesy of S. M. Berger, M.D.)

were reinserted. At the conclusion of the surgical procedure, 4 of the polyethylene drains contained bright yellow bile, three contained serosanguineous fluid, and one was empty.

A liver biopsy was taken during operation with the Silverman needle. Dr. I. Young reported that, histologically, extensive fibrosis was present. He noted that only a few nests of recognizable liver cells were seen (Fig. 23).

The immediate postoperative course of the patient was uneventful. During the first 24 hours over 300 cc. of bile was obtained. Bile pigment was present at a high level qualitatively. Additional chemical examination revealed 29 mg. per 100 ml. of cholesterol, 50 mEq. per liter of chlorides and 3.2 mEq. per liter of potassium. Specific gravity of the bile was 1.005.

An indwelling nasogastric tube was removed by the patient and was not reinserted because of normal findings on abdominal auscultation and palpation.

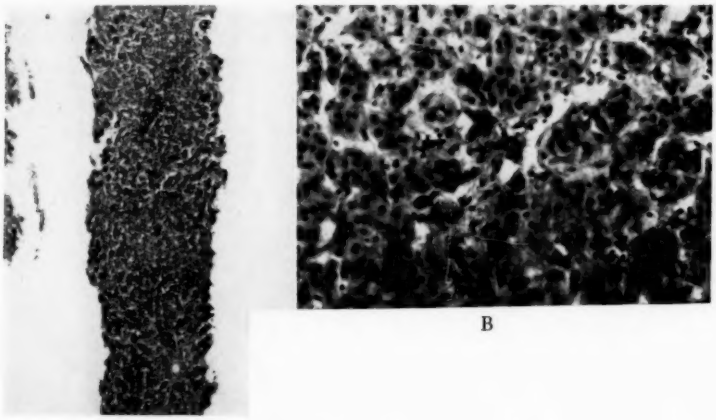
* Southey tubes obtained from Brotherston Company, Philadelphia.

Oral intake was resumed on the third postoperative day. Parenteral feedings were discontinued on the fifth postoperative day.

Scout films were taken of the abdomen and chest. These indicated that the Southey tubes were in the anterosuperior segments of the liver lobes (Fig. 24).

Postoperatively, hemoglobin was 12.4 gm. per 100 ml. Bile drained continuously from the polyethylene drains. From 75 to 200 cc. was collected daily. The child was active and afebrile.

On the ninth postoperative day the patient looked well; the icteric color was improved, while her physical activity and mental coordination were normal. On this day,



A B

Fig. 23. Liver biopsy. *A*, Low power view: sliver of mottled, yellowish-brown and grayish-white tissue presenting fibrotic nodulation. *B*, High power view: Sections of these rather large fragments show extensive fibrosis. The liver is represented only by a few nests of recognizable cells caught up in the fibrotic process. There is evidence of marked bile retention in these areas of the liver in the form of inspissation in bile canaliculi and of bile pigment in the cell cytoplasm. A few dilated spaces not lined by characteristic epithelium may represent dilated bile ducts, but the absence of lining thwarts positive identification.

however, gastric content was noted escaping around the polyethylene drains. Carmine administered orally appeared within 20 minutes on the abdominal wall. Within 12 hours an excoriated skin ulceration appeared. It was now obvious that wound healing was absent. Oral feedings were discontinued and parenteral feedings started. Blood and serum albumin transfusions were given in calculated quantity for the child's weight. This was supplemented by continuous invert sugar in electrolyte solution.*

Within 18 hours of the appearance of the gastric fistula the patient became lethargic, had obvious abnormal twitching movements and became febrile. This continued for 24 hours, when she returned to normal reaction and appearance. Thirty-six hours later she rapidly deteriorated, however, and died just as the glutamide solution was being prepared.

Essential laboratory data are summarized in the Table. Of significance are (1) anemia, including a pancytopenia, (2) persistent absence of bile from the stool, (3)

* Parenteral fluid electrolytes included sodium, 25 mEq. per liter; potassium, 20 mEq. per liter; magnesium, 3 mEq. per liter; and chlorides, 22 mEq. per liter; lactate, 23 mEq. per liter; and phosphate, 3 mEq. per liter. In addition, 10 cc. of 10 per cent calcium gluconate was added each day.

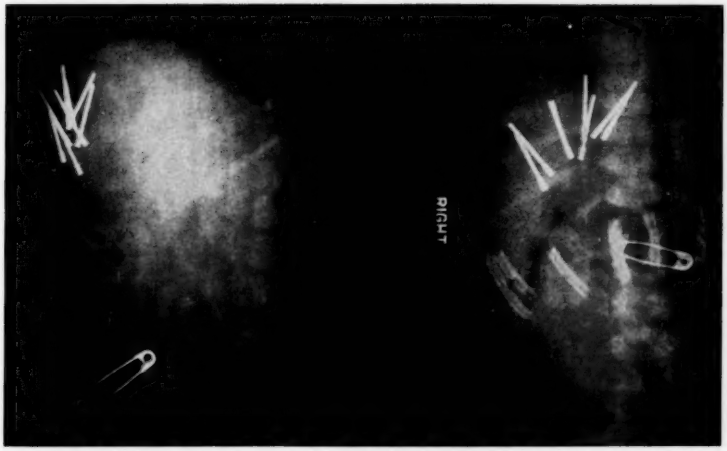


Fig. 24. Anteroposterior and lateral projections indicating 8 Southey tubes placed in the anterosuperior segments of both lobes of the liver. There is no evidence of subdiaphragmatic or subhepatic collection.

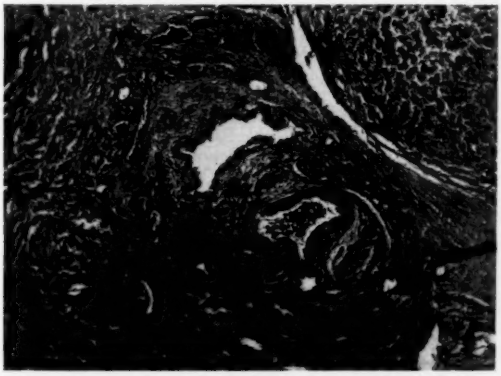
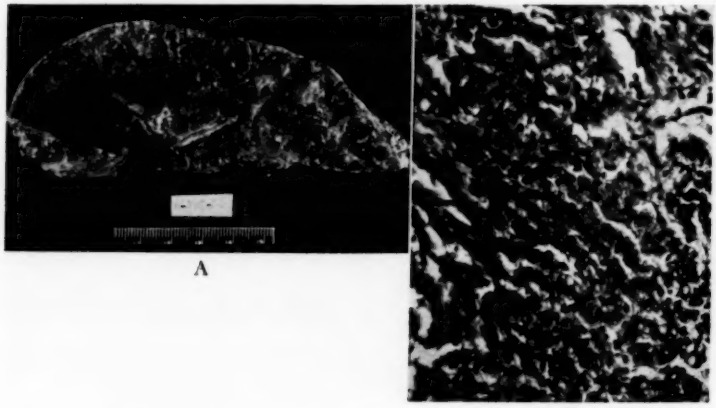


Fig. 25. Hepatogastric anastomosis (high power view) indicating fibrous demarcation, with no communication between the liver (upper right) and the gastric wall (lower left).

failure of serum bilirubin to exceed 21 mg. per 100 ml., and (4) marked reversal of albumin-globulin ratio. Alkaline phosphatase was slightly elevated. Unfortunately, not all the examinations which were desirable could be obtained, since available sites for venipuncture had been obliterated in the cutdowns required for treatment of the previous gastrointestinal hemorrhages.

Autopsy examination was done by Drs. William Glantz and Irving Young. Of significance was the extreme icteric and green staining of all tissues. Tremendous varicosities were present in the lower esophagus. The gastric fistula was not too obvious, since there were many adhesions between the stomach and liver. The hepatogastric anastomosis was not functioning, and there was complete sealing of the liver (Fig. 25). The

Southey tubes were in place at the porta hepatis. There was no evidence, however, of sinus formation. The cut surface of the liver presented marked distortion of fibrotic tissue (Fig. 26). Around the porta hepatis were numerous black green concretions which resembled bile lakes. (Fig. 27). These were seen occasionally in the central portion and rarely in the periphery of the liver. It was not possible to identify the gall-



A B

Fig. 26. A, Cross section of liver indicating extensive fibrosis. There are few or no bile ducts obvious in the periphery. There are several dilated areas containing inspissated green concretion near the hilum. *B*, Microscopic distortion and disorganization of liver lobules indicating hepatic cells, with the suggestion of bile duct formation.

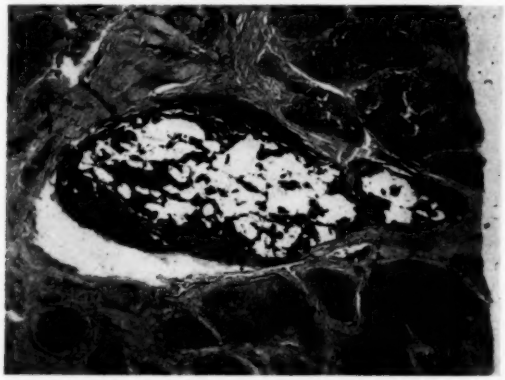


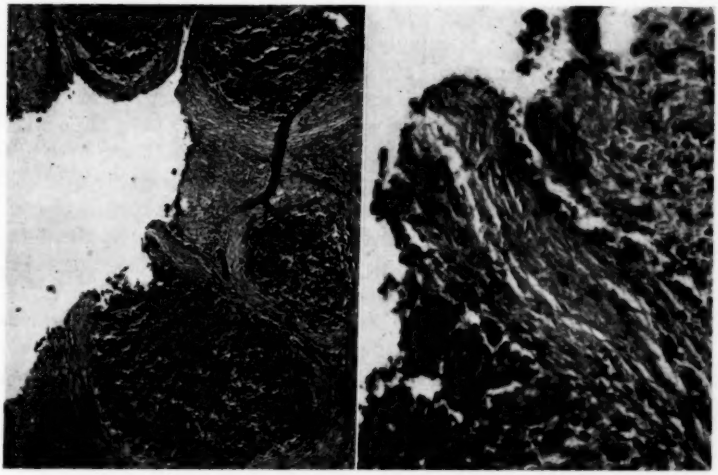
Fig. 27. Section taken through the bile lakes.

bladder, the hepatic ducts, the cystic or common ducts. The papilla of Vater, however, was seen to drain a dilated pancreatic duct. The pancreas was grossly normal except for widespread intercalary duct dilatation. The spleen was enlarged, congested, and fibrotic with accentuation of the lymphoid follicles with minimal bile staining. The abdominal, inguinal and retroperitoneal lymph nodes were markedly enlarged and heavily bile-stained. Microscopically, sections of the liver revealed complete archi-

tectural disorganization (Fig. 28). Severe and diffuse fibrosis was interspersed with scattered nodules and nests of liver cells. Much of the hepatic parenchyma was atrophied, necrotic and disorganized. Bile pigment was visualized in canaliculi and in cellular cystoplasm. Occasional structures were seen which could have been bile ducts. Sections taken at the hilum failed to reveal epithelialization of the sinus tracts associated with insertions of the Southey tubes.

The lymph nodes had tremendous accumulations of bile pigment in the sinusoids.

The kidneys were congested; glomeruli and tubules were intact and well preserved. However, there were inspissated bile casts in the tubules. In addition, the larger arteries



A B

Fig. 28. Sections taken through the hilum at the location of the Southey tubes indicate only disruption of the hepatic lobar architecture, with incomplete evidence (after 10 days) of epithelialization of any sinus tracts. A, Low power view (× 29). B, High power view (× 250).

showed moderate intimal thickening. Gross and microscopic studies of the blood vessels, adrenals, pancreas, uterus and ovaries, bone marrow and neck organs revealed no gross or microscopic abnormalities. There was no evidence of wound healing in the incisional area.

DISCUSSION

Ladd[16] and Gross[12] indicate that only 30 out of 150 patients with congenital bile duct atresia are subject to immediate surgical correction. Few successful cases, however, are reported.[2, 4, 7, 8, 10, 12, 18, 20, 21, 22, 25] The usual life expectancy is for six months. Even in the irremediable state, however, wherein no extrahepatic duct exists, children with bile duct atresia have been known to survive for several years.[11] The case of C.P. reported here is most unusual in that the child survived for four years.

The reason for longevity in some of these children has been explained by Ahrens.[1] He postulated that children who have both intrahepatic and extrahepatic duct atresia will live longer than those who have only extrahepatic duct atresia. As an additional observation, Moore[20] found that biliary fibrosis and cirrhosis were most pronounced in infants who died at a few months of age. He found that proportionately less advanced cirrhosis was found in infants who survived for two or more years. The combination, then, of total (intrahepatic and extrahepatic) bile duct atresia, together with meager fibrotic or cirrhotic changes, would favor longevity in infants with the bile duct atresia. The case of C.P., reported here, would not agree with these observations. In this patient, marked hepatic fibrosis and severe cirrhosis were present.

As in this patient, others have noted the existence of the "bile lakes" at the hilum, containing inspissated bile-stained debris. These have been interpreted[13, 14, 15] as representing dilated, large intrahepatic ducts. By contrast to these areas at the hilum, the peripheral liver contained nothing which significantly represented bile ducts. Accordingly, the Longmire procedure[17] would not be expected to provide drainage of bile in infants with congenital bile duct atresia.

Others have utilized similar techniques to obtain bile in these infants.[10, 25] Cases have been reported with maceration or puncture techniques wherein external bile fistulas were obtained for short intervals. I have seen that use of the multiple Southey tube insertion at the hilum can provide a continuous, prolonged external bile fistula.[13] However, drainage of a small segment of liver cannot prevent other lobules from the eventual cirrhotic degeneration.

The next step in management of this condition would be to provide complete drainage of the entire liver as soon as possible. If the cirrhotic process were then isolated in the periphery, it is possible that growth and regeneration in areas of the liver drained by the Southey tubes might increase sufficiently in size and function to provide normal hepatic physiology.

Of extreme interest is the fact that the child died in hepatic coma. This was coincident with a higher level in red blood cells and hemoglobin than the child had enjoyed for over two years. It also followed administration of large amounts of albumin and proteins. These last were indicated to provide nutritional elements for wound healing; they were insufficient, however. Yet sufficient protein must have been available to provide an impetus towards the hepatic coma.[24]

In any case, when the newly born infant is observed to have obstructive jaundice, a desirable plan would be the following:

1. Establish a clinical diagnosis
2. Do an exploratory laparotomy (small incision)
   a. Obtain liver biopsy for histologic study

b. Identify gallbladder (or ducts) and attempt operative cholangiogram[26]
3. Reoperate, if diagnosis is established
   a. Relieve obstructive jaundice
      (i) Anastomose dilated proximal hepatic duct to intestine
      (ii) Establish external bile fistula.
         (a) Convert external bile fistula to an internal one, if feasible.

SUMMARY

A case is reported of a four year old girl who had survived to that age despite total bile duct atresia. This patient had hepatic cirrhosis, hepatosplenomegaly and portal hypertension with recurrent severe hemorrhages from esophageal varices. Anastomosis of the liver to the stomach was unsuccessful. In this patient an external bile fistula was established by the insertion of Southey tubes at the porta hepatis. The patient died in hepatic coma.

(Clinical management in this patient was assisted by Drs. Ralph Goldsmith, William T. Livingston, Robert Schless and Henry Tumen. Laboratory and pathologic observations were made by Drs. Henry Brody, William Glantz, Edward Kessler and Irving Young.)

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